MACHINE DESIGN

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1/4 OUNCE BEARINGS

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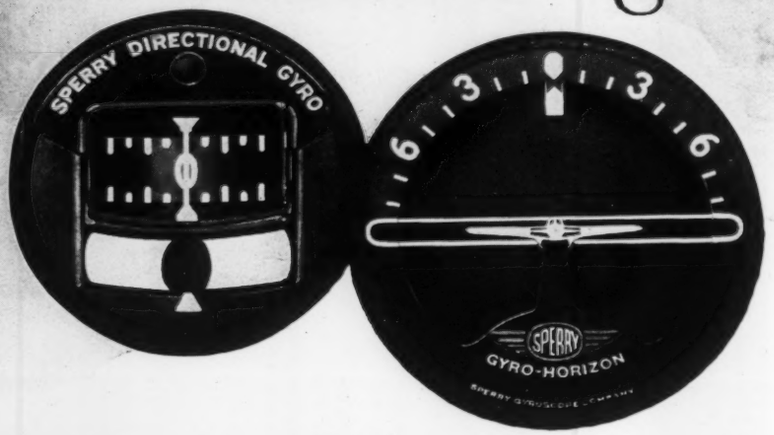

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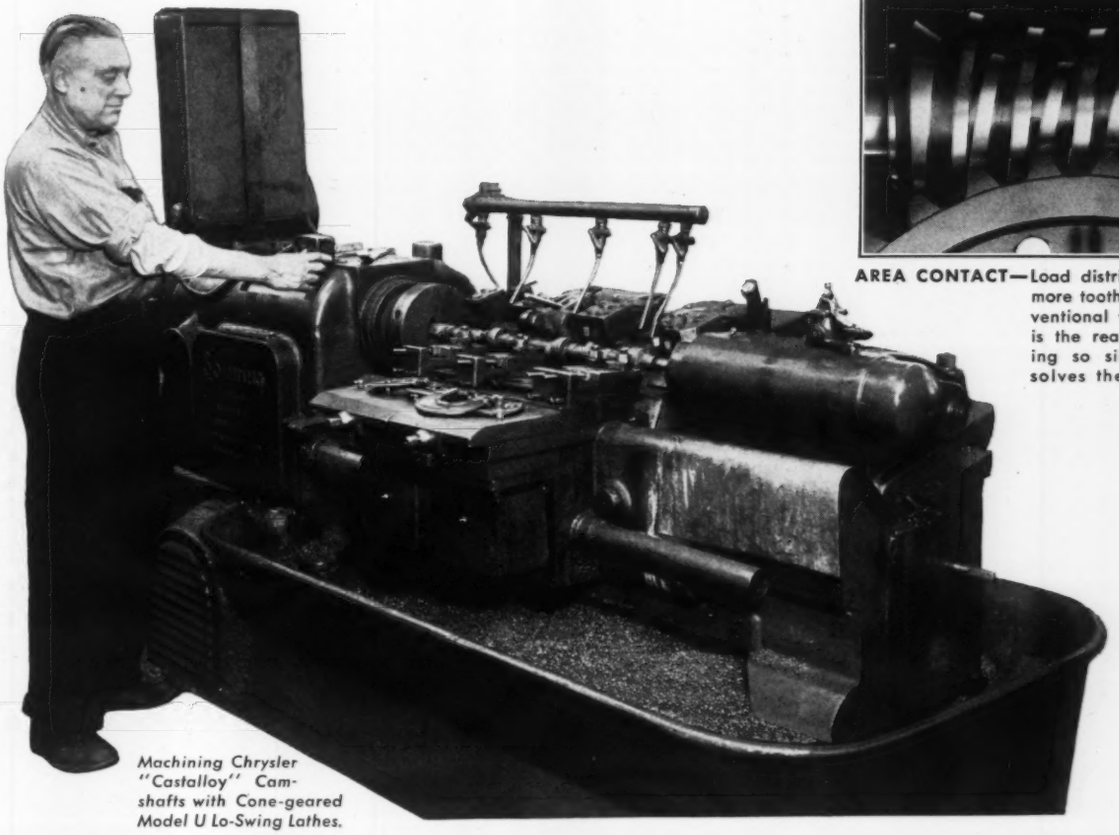
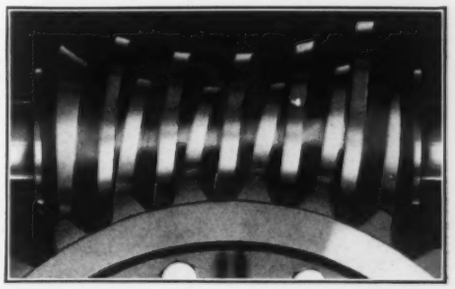


Machining Chrysler "Castalloy" Camshafts with Cone-geared Model U Lo-Swing Lathes.



AREA CONTACT—Load distributed over 30 times more tooth surface than in conventional worms and wheels—is the reason why Cone gearing so simply and efficiently solves the gearing problem.

WHEN THE GOING IS TOUGH

As in the machining of the new tough "castalloy" camshafts at Chrysler, it is imperative that the machine tools used may be depended upon for efficient, trouble-free performance regardless of overloads. That's why Model "U" "Lo-Swing" lathes (above) are "Cone-geared" for that extra reliability and efficiency.

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TOPICS

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* * *

Almost as great as the dislike of students for examinations is the apathy of teachers toward correcting test papers. A boring drudgery, teachers have been known to grade papers according to their weight or neatness rather than for factual content. But it would seem the day of salvation is at hand for a machine is now on the market which marks examination papers at the rate of 600 an hour, 60 to 100 times faster than a human being, and does not permit human errors to creep into the grading! Of course, the machine will not ponder the fine points of a difficult question or write a note of advice in the margin, but in exams of the "choice" type in which the student indicates the answer to each question by marking in one, two or three available columns, the machine does the job without difficulty.

Its operation is based on the fact that graphite in lead pencils is a conductor of electricity. When a test sheet is inserted the machine instantly indicates all of the answers on it. The test paper bears against a plate with 750 electrical contacts; if a pencil mark bears against one of these the circuit is completed and the question graded. The machine is set for each test by inserting a master sheet on which the answers are correctly indicated.

* * *

War or the possibility of war always spurs inventors and engineers to design machines that otherwise would not appear for decades. Recently we have received word of a hydrogen engine designed by the Germans for use in submarines which will obviate the old method of obtaining power from heavy, bulky batteries. Off peak power from hydroelectric stations is fed to electrolyzers which separate water into its component elements—hydrogen and oxygen. The gases are stored in steel cylinders and burned together in the submarine hydrogen engine.

The gases can be burned in a regular diesel engine with little conversion, and the steel cylinders take up about one-half the space and weigh much less than batteries. The product of combustion, water vapor, is condensed and sent back to the empty cylinders keeping the weight of the submarine practically the same. Space and weight are saved by this method and the danger of lethal gases escaping, as is the case with batteries, is eliminated.

* * *

Machine tool makers who have gone through years of tough sledding are finally realizing the "more abundant life." Only once in history has the demand for machine tools exceeded the sensationa' ly high levels established during the closing months of 1936 and carried over into 1937. The sole instance on record was in 1919 which was admittedly an artificial and inflationary period. In the closing days of the war, machine tool demand topped the 210 index number in the three-month moving average of new orders. Last month the three-month average again passed the 200 mark and during December domestic and foreign business together reached the all-time peak of 257.7, according to the National Machine Tool Builders' association. The 18 year average from 1919 to 1936 was 77.7.

MACHINE DESIGN

Heat Treatment as It Affects the Designer – Part I

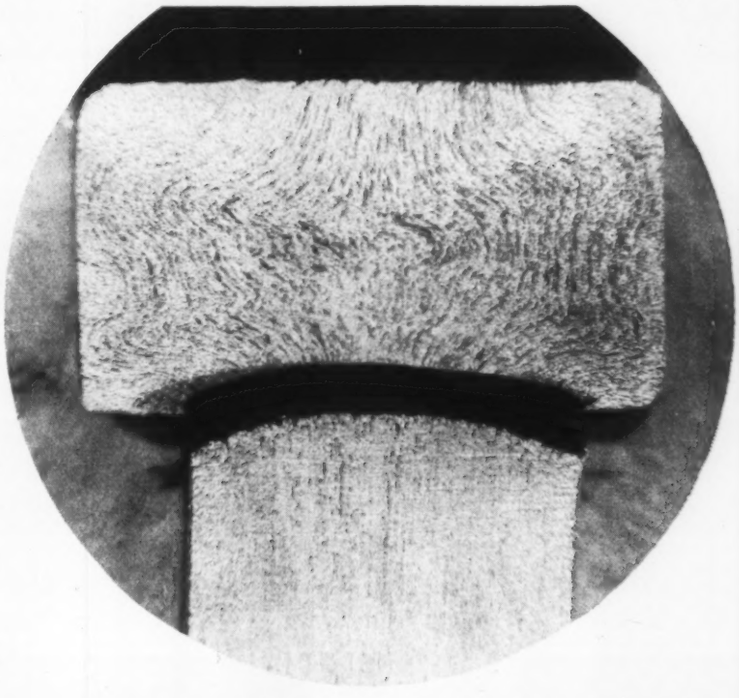


Fig. 1—Shaved to sharp corner under head, this heat-treated cold upset screw failed in tension. 10X mag. of etched sections, shown full size

By Guy Hubbard

HEAT treating in its broader sense is a scientific subject for which the machine designer should have such a degree of respect that he will hesitate to attempt the role of metallurgist. At the same time he should not fail to recognize that today definite and authoritative specifications on working drawings of metals and their treatment is fully as important as are proper dimensions, manufacturing limits and notes as to machining. Close co-operation between the engineering department and a competent metallurgist is highly desirable throughout the development of a machine to insure economy in its manufacture, safety in operation and long life in service.

In the days when the heat treating department of the average machine company was just a blacksmith shop and alloy steels were curiosities, metallurgical in-

structions on drawings ordinarily were limited to such casual notes as *"C. R. Steel, Pack Hardened," "M. S., H. & G.," "Tool Steel, Spring Tempered"* or *"Drill Rod, Harden Small End."* Even then they left much to the ingenuity and imagination of the shop men. Certainly such symbols are definitely out of place now when the choice of steels and range of treatments have broadened so tremendously.

While small shops cannot afford a metallurgist or an elaborately equipped heat treating department and laboratory, any machinery building organization worthy of the name can afford at least occasional sessions with a consulting metallurgist or can send out important parts to heat treating specialists in case the necessary treatments are beyond the ability of the shop's own equipment and personnel.

Specifications Need Checking

The ability of the equipment and personnel of most heat treating departments however, is ahead of the unaided ability of the average draftsman to specify steel and its handling, if one can judge from some of the drawings which are submitted to manufacturers of screw machine products and other machine parts. These manufacturers are constantly performing yeoman service for their customers by calling attention to faulty metallurgical specifications and to design features which are questionable from the metallurgical point of view.

In a discussion of this situation with the metallurgist of a well known parts manufacturing company, he set forth the following as facts about which he believes machine designers in general should be informed. Above all else, he emphasized that sharp corners should be avoided in parts to be heat treated. Wherever possible, generous fillets should be provided, the mating part being chambered if necessary to make room for the fillet. An example of the bad effect of a sharp corner is given by *Fig.* 1, while *Figs.* 2 and 3 indicate how trouble of this kind can be forestalled on the drafting board.

Parts which are to be subjected to heavy stresses, especially alternating stresses, should be kept free from tool marks. One way that this can be assured is for the draftsman to specify that they be finished by grinding. If parts are to be carburized, the drawings should be checked carefully to make sure that there are no sections so thin that the combined cases will equal the web thickness.

From the heat treating standpoint longitudinal and cross drilled oil holes in shafts to be carburized are undesirable. They weaken the parts. The metallurgist recommends that if the designer can think of some other practical method of applying lubrication, its adoption is desirable.

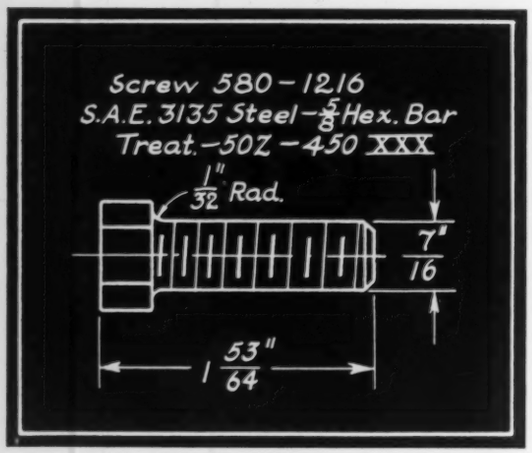


Fig. 2—Heated to 1500 degrees and quenched in oil, with fillet under head increasing strength

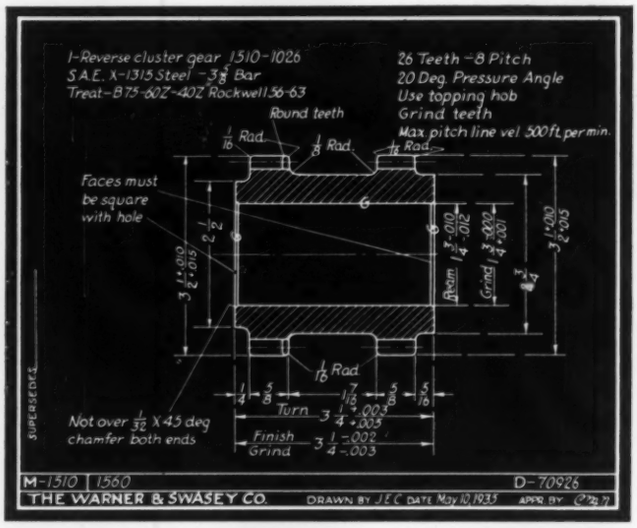


Fig. 3—Carburized .020 deep, this is twice reheated and oil quenched—from 1600, then from 1400 degrees

Speaking of choice of material, the metallurgist suggests that designers and draftsmen bear in mind the basic facts as to SAE steels expressed in the following table:

SAE Nos.	Strength	Toughness	Machinability
1020 } 1025 }	Low	Good	Fair
1112	Medium	Low	Excellent
1030 } 1035 }	Medium	Good	Good
2330 } 3135 }	High (If heat treated)	High	Fair (If annealed)

His view of the matter is that the foregoing short list of SAE steels will cover practically all parts subject to tensile stresses, and also torsion members, where wear resistance is not of great importance as is the case of many shafts, links, fastenings and structural members.

Where wear resistance will be necessary, case hardened low carbon steel, hardened high carbon

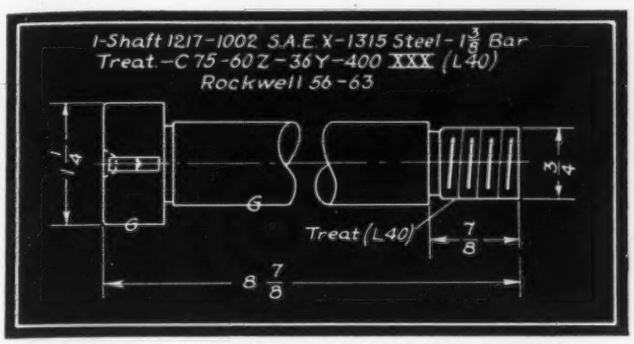


Fig. 4—After carburizing and two reheats and oil quenches, one end is drawn in lead at 1400 degrees

steel, hardened high speed steel, or stellite or other forms of hard facing, are possibilities, the choice of which should be made in consideration of the service. Parts requiring good wear resistance, under low unit stress, on which a few thousandths of wear will necessitate replacement, can be made of SAE 1112 steel hardened in cyanide. Recent developments in activated cyanide baths make it possible consistently to obtain uniform, file hard, and highly wear resistant cases to depth of .025-inch.

Parts subject to moderately high crushing stresses and requiring good wear resistance (pleasure car transmission gears for example) may be made of some oil hardening steel such as SAE 5750 or 6150 with light cyanide case. When high crushing stresses and good wear resistance both are involved, low carbon alloy steel, case carburized and hardened; or high carbon steel, hardened, are in order.

As a general thing alloy steels should not be specified on drawings unless the parts are to be heat treated. Sometimes the bar stock itself had better be treated before machining. The engineering department should bear in mind that if parts are to be made on automatic screw machines the Brinell hardness of the material specified should be below 300. For higher ultimate strength, lower yield and greater elongation the parts should be heat treated after machining, when higher hardness is allowable.

Materials and Methods Change

Designers should give careful attention to required stiffness of machine parts. How design thinking in this direction has been influenced by materials and methods is illustrated by automotive crankshaft developments over a period of twenty-five years.

First came the untreated steel shaft equivalent to SAE 1025. Next, heat-treated alloy shafts, tough and strong but in many cases too thick for proper rigidity. Then heavier shafts of SAE 1045 steel, featuring stiffness and with large bearing surfaces. And now cast iron crankshafts, competing with steel shafts—the latter in some cases having bearing surfaces locally hardened by an almost instantaneous electrical induction method. All of which proves that the metallurgist constantly must "keep on his toes", and that the designer constantly must keep in touch with the metallurgist.

While simple heat treatments could be expressed on drawings as "long hand" notes "giving the whole story", this method—if carried out in all cases—would clutter up the sheets with a mass of lettering. Therefore use of "shorthand" symbols is desirable. Some companies have worked out their own, while others have adopted systems such as that suggested by the Society of Automotive Engineers. The significant point is that more and more companies are having their engineering departments—with the co-operation of metallurgists—put definite, correct and complete metallurgical specifications on their drawings.

Designer Plus Metallurgist

As an example of a smoothly working team of machine designers and heat treating specialists, that of the Warner & Swasey Co. is worthy of emulation. Co-operation between the engineering and metallurgical departments of that company has been going on for many years, with the result that every part has been, and constantly is being, studied metallurgically in relation to its function. Steels and their treatment are specified accordingly and at the same time care is taken to see that the parts are properly shaped to react favorably to heat treatment.

Through the kindness of Stephen Lawson, chief engineer, and D. M. Gurney, metallurgist, the writer has been given some insight into the Warner & Swasey

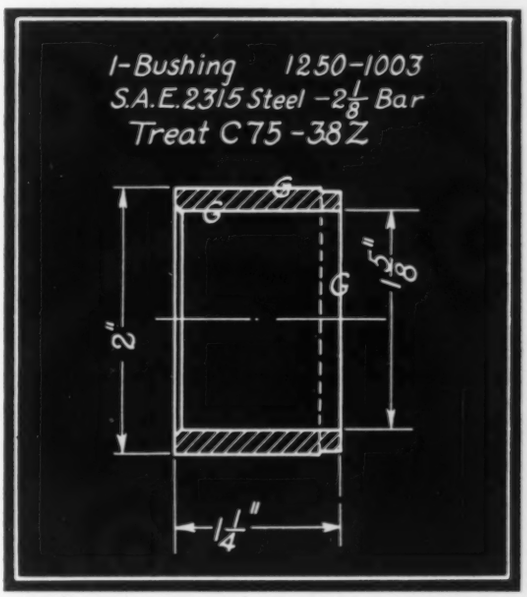


Fig. 5—Symbols in this instance translate into "Carburize to depth of .030-inch at 1750 degrees"

methods, of which the simplified blueprints shown herewith present merely a few random selections. It will be noticed that while the kind of steel is expressed by SAE numbers, and hardness by Rockwell numbers, treatments are set forth by a system of symbols which has been worked out to meet the requirements of this company.

Briefly, all heat-treating operations are classified under five heads: Heating medium; temperature of heating medium; time of heating; quenching medium; and temperature of quenching. Symbols are used to express each of these five, therefore a combination of five symbols describes a heat-treating operation. When several operations are performed on a single part, the corresponding groups of symbols are separated by a hyphen. Enclosure of a symbol or group of symbols in parenthesis denotes that the treatment so enclosed is to be given only to that section of the part indicated by limiting lines on the drawing, as in *Figs.* 4, 6 and 7.

Without attempting any complete description of the system, it may be said to be built along this line. Letters *A* to *E* when used as first symbols denote use of a carburizing medium, each one indicating a specific depth of penetration. Letters *F, L, P, Z* and *S* in the first symbol denote respectively "Furnace," "Lead bath or substitute," "Cyanide," "Oil," and "Salt." When the heating symbol is not given, choice of *F* or *L* is up to judgment of operator.

Temperatures up to and including 999 degrees Fahr., and 2000 degrees and above are set forth in full, but those from 1000 to 1990 degrees are expressed by the two middle figures only, the first and last being understood to be 1 and 0 respectively. The temperature symbols are always given. Time in minutes are expressed in Roman numerals and hours by Roman numerals with

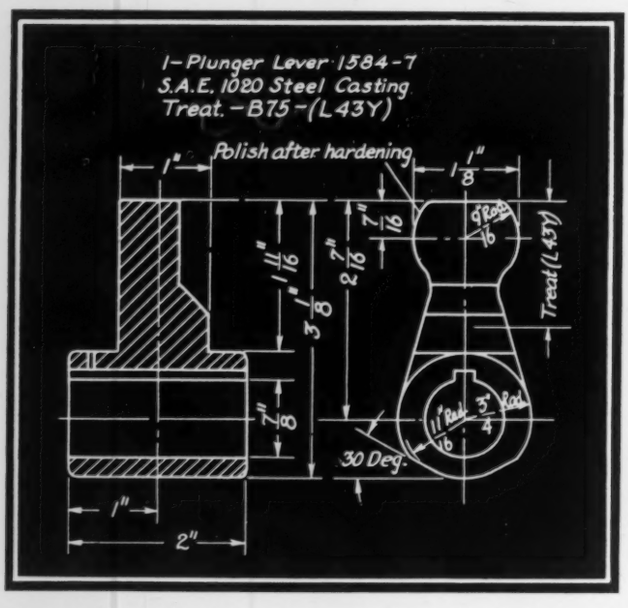


Fig. 6—The knob only on this carburized lever is hardened by heating in lead and quenching in water

a horizontal line through the middle of each. When the time symbol is not given, it is understood that it shall be heated thoroughly, time being up to judgment of operator. When not given on carburizing, required depth of penetration governs.

When used as fourth symbols, *A, B, L, F, X, Y* and *Z*, meaning "Air," "Air blast," "Lead," "Furnace," "Brine solution," "Water," and "Oil," respectively, represent the quenching or cooling medium. When not given, *A*

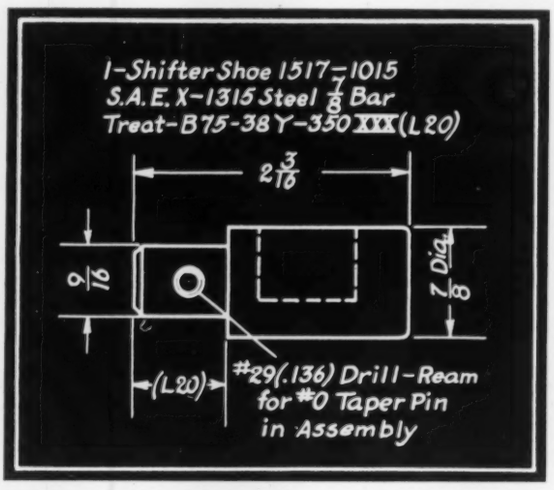


Fig. 7—Local treatment in this case consists of drawing the small end in lead at 1200 degrees

is understood. When actual temperature of quenching or cooling medium is not given, the letters *A, F, X, Y,* or *Z* as fifth symbol mean respectively "Room temperature," (60 to 80 degrees Fahr.), "Cool with furnace," "100 to 150 degrees Fahr.," "60 to 80 degrees Fahr." and "80 to 100 degrees Fahr."

Through this or any comparable system, even the more elaborate heat treatments can be set forth in detail on a drawing by a combination of symbols in no more space than would be required for a simple algebraic expression. Bearing in mind that the foundation of such a system is that group of five basic factors entering into all heat treating operations, it is obvious that both engineers and metallurgists very soon become so familiar with it that they use and translate the symbols with little or no effort. However, this does not mean that draftsmen should make promiscuous use of them without definite instructions or checking by the metallurgical department.

As a final word it can well be stressed that no heat treating note on any drawing ever should be considered as the "last word." Metallurgy is a living, breathing science which is growing bigger and better all the time. What is the best practice today may be obsolete tomorrow because of new steels and new treatments and the wide-awake metallurgist working with progressive designers will see to it that metallurgical specifications on drawings frequently are changed accordingly.

SCANNING THE FIELD FOR IDEAS

MECHANICAL refrigeration still is generating a tremendous amount of inventive thought on the part of engineers and designers. This is indicated by a recent development by the York Ice Machinery Corp. by means of which ice is produced with great rapidity in the form of ribbons.

The FlakIce machine is shown diagrammatically in *Fig.* 1, this being an end view in operation. The machine consists of an insulating housing and tank within which is a revolving, water-immersed, divided cylinder driven at center and both ends by ring gears. The cylinder illustrated is made up of fourteen flexible metal rings or bands (seven each side of the center ring gear) separated by rubber strips.

Within the flexible cylinder assembly is a stationary drum pierced with numerous nozzles through which precooled calcium chloride brine is constantly sprayed against the inner surface of the flexible cylinder. While this "freezing" cylinder retains circular form throughout the greater part of its circumference, it is made to develop a "hump" at the top by an internal roller.

As the cylinder revolves in its surrounding water, ice forms progressively on the metal rings. At the point where the rings change shape over the roller, this ice automatically peels off and is deflected over a chute into a storage bin in the form of flakes about ⅛-inch thick, 6 inches wide and 5 inches long. All bearings and rubbing surfaces within the tank are designed for brine or water lubrication.

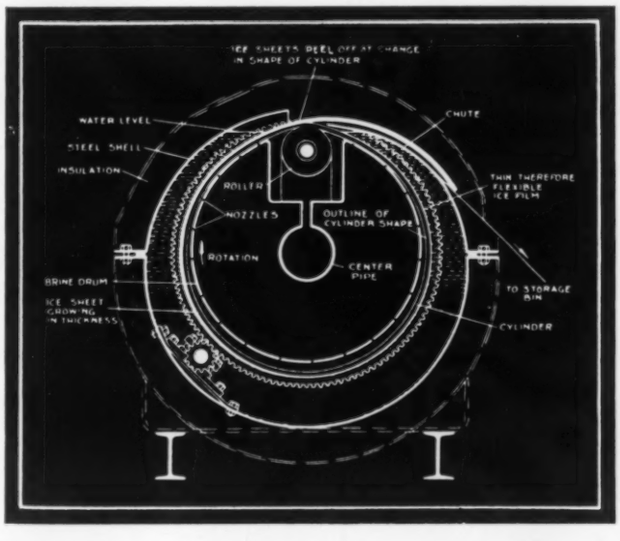


Fig. 1—Ice is produced in form of continuous ribbons by action of a revolving drum with a "hump" on top

Controls Time Cycles

WHEN it is desired to control machine operations electrically by means of solenoids and magnets in definite timing sequence, this often can be accomplished successfully by means of time cycle controllers utilizing mercury switches.

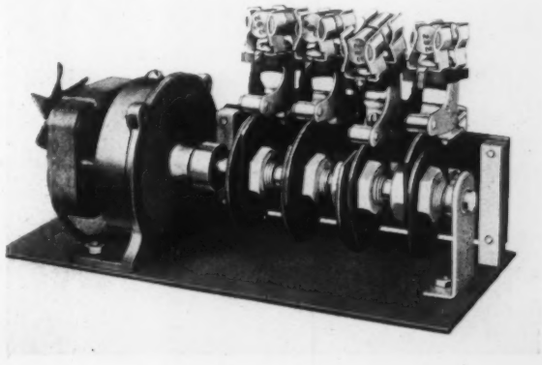


Fig. 2—Mercury switches are operated progressively by a system of adjustable Bakelite cams

There is depicted in *Fig.* 2 an automatic controller of this variety developed by the Electric Switch Corp. for use with Staley metallic mercury switches. In designing these mechanisms several points have to be taken into consideration—the most important being elimination of chatter. The cams, which are adjustable, are made of Bakelite and are so shaped that movement of the switches is started and stopped gradually.

Cam followers preferably should not be allowed to

drop violently from the peak of the cam. However, if violent operating action is unavoidable, it should be damped by having the rockers come to rest against rubber or felt dampers both at "make" and "break."

Keeps the Engine Warmed Up

JUST as the mechanism of an electric refrigerator starts and stops automatically to maintain the proper low temperature within the box, so also through the use of an attachment called the Moto-Heater is the engine of an automobile made to start and stop to keep it warm in cold weather. This device, which is shown installed in *Fig.* 3, is designed to act when the car is in an unheated garage or when it is parked with ignition and doors locked.

If for any reason the motor does not start immediately, or if the car has been left in gear, the device instantly locks in "safe" at its first subsequent operating trial. Also, if the gasoline supply becomes depleted or if for any other reason the motor refuses to start after a reasonable "trial period" (which is adjustable) the device locks "safe" and remains inoperative until the difficulty is eliminated.

As is apparent in the illustration, the unit is mounted on the water hose between engine and radiator. The thermal plate which constitutes the back of the unit is punched outward to form numerous sharp points similar to the teeth of a grater. These points perforate the outer skin of the hose, thus facilitating thermal pick up of water temperature changes and at the same time holding the case permanently in position in relation to the hose and the air stream from the radiator fan.

Setting of the thermostatic element is adjustable so that any proper temperature of water can be maintained closely. The operating differential between "on" and "off" is 20 degrees Fahr. The case is sealed to prevent any unauthorized tampering. In addition to keeping the engine warmed up, the device also serves to keep the battery fully charged at all times, the motor being operated by it at battery charging rate. Binding posts are provided for connections through which automatic operation of the car heater can be maintained, thereby keeping the interior of the car comfortably warm at all times.

The control circuits of the unit are designed to provide full automatic control of the motor in complete independence of the manual control system, but at the same time it is impossible for one system to become crossed with the other. Some idea of the wiring hook-up can be gained from the illustration.

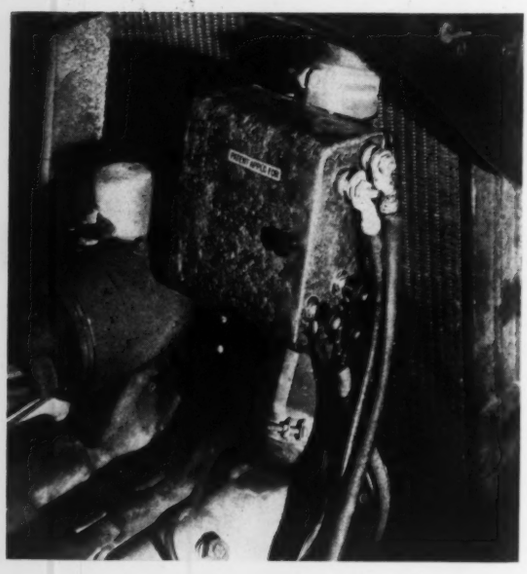


Fig. 3—Thermostatic unit starts engine automatically, to protect it against freezing

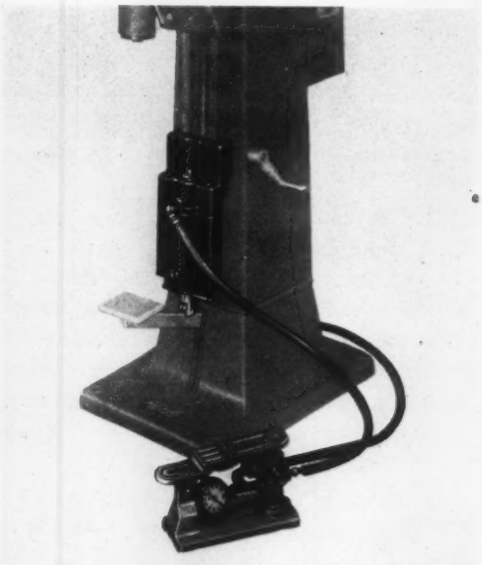


Fig. 4—Accurate control of tapping pressure is attained by using compressed air

Tap Pressure Is Gaged by Air

WHEN running a tapping machine the operator has constantly to be on guard against subjecting the tap to overstrain. Unless the system of control is very sensitive, it is difficult to "play safe" with the tap and at the same time maintain high production.

To solve this problem the designers of R. G. Haskins Co. have applied compressed air to the feedworks of a tapping machine, the principles of their system being shown in *Fig.* 4. On the type of machine involved, the tapping operation ordinarily is controlled quite sensitively by direct action of the operator's foot, pressure on a foot pedal being transmitted through a "safety pull spring" to the head.

To attain still greater sensitivity, however, and at

the same time to reduce operator fatigue, an auxiliary air cylinder unit has been designed to be clamped to the column of the machine. This is set in position

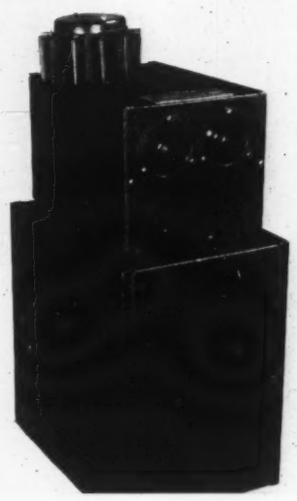


Fig. 5—In this unit are combined a light ray source and an "electric eye", the ray from the source being reflected back into the eye across the pathway of moving objects

to actuate the mechanical foot pedal by means of a downward directed piston rod the roller end of which presses upon the pedal shank. Movement of this piston rod is in turn controlled by the operator's foot which rests lightly on a pedal valve cut into the compressed air supply line.

"Ray" Reflects to "Eye"

INSTALLATIONS of the so-called "electric eye" or dinarily have involved use of two separate and distinct units—one a light source with lenses for projecting the parallel "ray," the other a receiver in which the ray falls upon the light-sensitive element through the medium of which electrical action is attained. While mere application of the electric eye as a control means no longer can be considered as a novelty, the methods of application are being improved from time to time.

A case in point is the Teletouch Ray unit of which an illustration appears on this page as *Fig.* 5. This self-contained instrument combines the ray projector and ray receiver in a single housing, this being mounted on a base which contains the relay mechanism through which the electrical reaction of the light-sensitive element is amplified to do the work required of the unit—which may be counting, opening of doors, turning on of lights and numerous other functions which can be controlled advantageously through interruption of a beam of light.

The combined projecting and receiving unit, which has much the appearance of a stereoscopic camera, has at the left a light source and at the right a receiving window or "eye". The ray from the left window—after traversing the space through which moving objects will pass—is reflected back into the right window or eye.

This apparatus can be set up quickly and unobtrusively in places where use of a separate light source would be objectionable or impossible.

X-Rays from Pendulum

WHEN taking a photograph with long exposure, such as a street scene in semi-darkness, persons passing in front of the camera either will not register on the plate at all or only as a faint shadow.

This effect now has been applied to X-ray photography by German scientists who have developed an apparatus called the Tomograph, shown in action in *Fig.* 6. This consists of a double pendulum on the long arm of which the X-ray tube is adjustably mounted above the subject, while the film carrier is mounted in a parallel device on the short arm of the pendulum below.

To take a clear X-ray photograph of a definite section or thin layer within the body—in the lung for example—the apparatus is regulated so that its swing is around a point lying at the height of the desired section. While the exposure is being made the pendulum swings, the X-ray focus moving along the arc of a circle from left to right while the film moves simultaneously from right to left, at the same time remaining constantly parallel to the plane of the desired section.

Thus every point in the plane of that section always falls on the same point of the film, notwithstanding the constant movement of tube and film. At the same time all other points above and below that section are projected at constantly changing points on the film. Ribs for instance are thus eliminated from the photo.

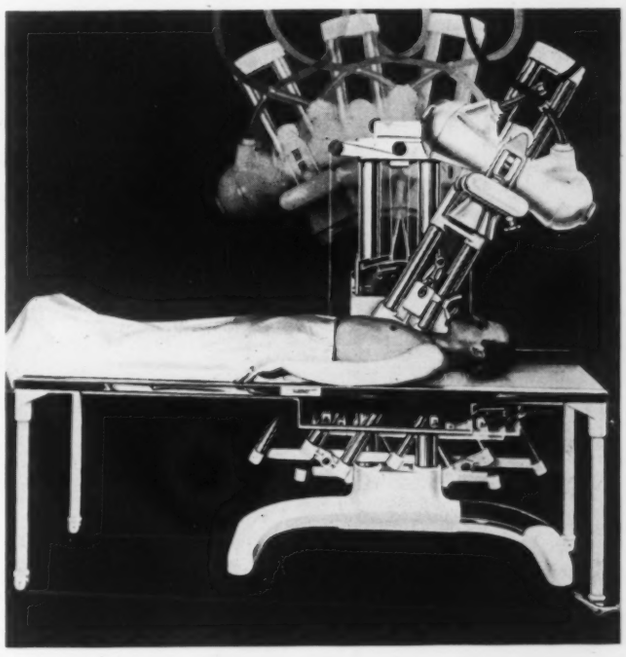


Fig. 6—Swinging apparatus on double-armed pendulum eliminates interferences in X-ray photos

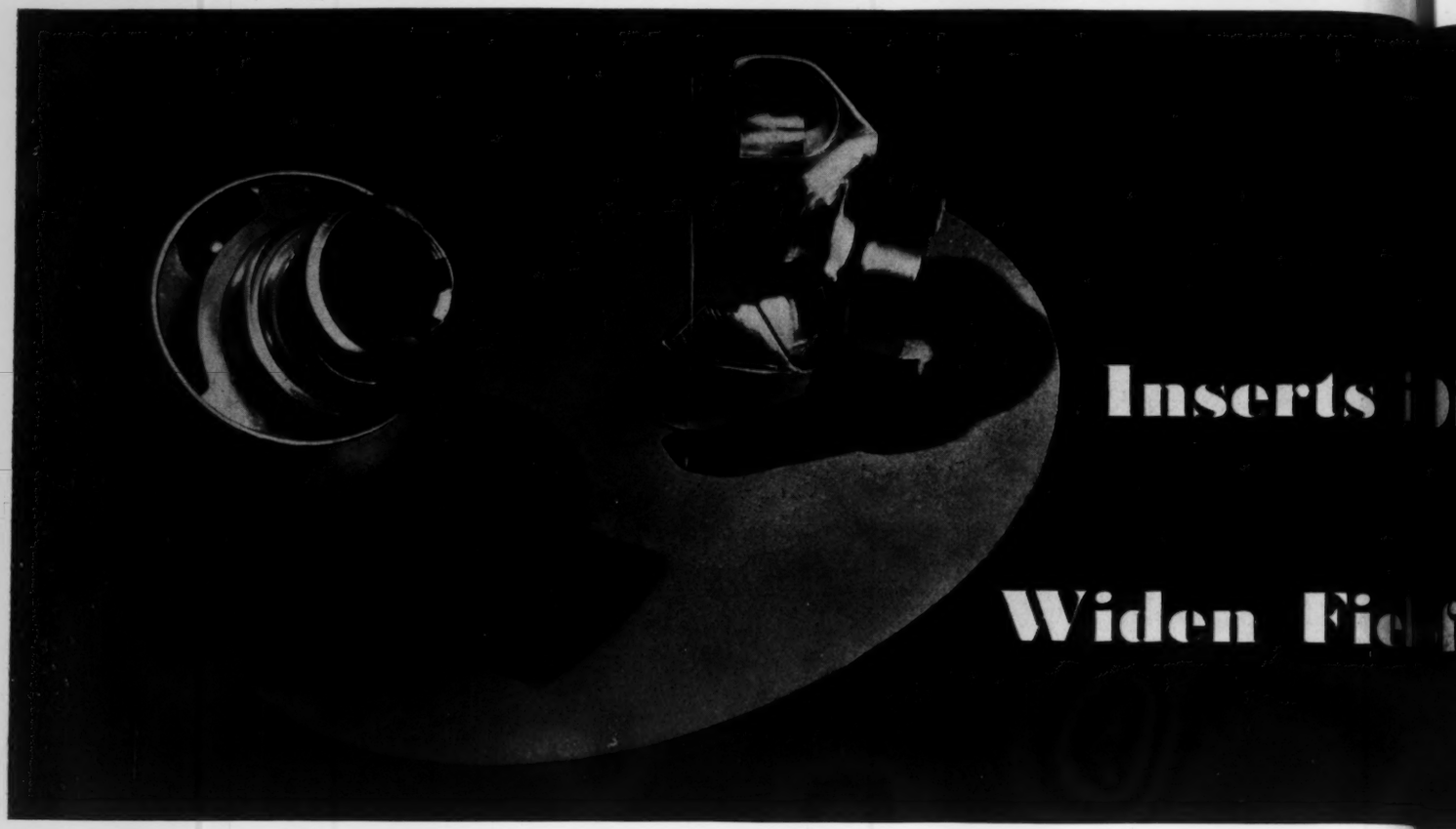


Fig. 1—Hardened race is die cast as insert in universal joint

DIE castings are often and rightly considered as more or less competitive with stampings, sand castings, plastic products and even in some cases with forgings or screw-machine products. But a study of their application makes it apparent that they are more often used as complementary or supplementary parts of assemblies containing these supposedly competing products. In other instances, to be considered here, these other products actually become a more or less integral part of the die casting which benefits by their inclusion. The die caster calls the cast-in elements "inserts" and recognizes their advantages as extending the range of utility of the die casting, even though he may not always welcome their use. Such mild opposition, if it can be called such, is based on the fact that inserts tend to slow the casting cycle by a time equal to that required to place them in the hot die. If allowance for this is made in the price, as in justice it should be, the ground for opposition is largely removed.

Inserts are used with considerable advantage and for diverse reasons. Often they add strength at a certain point or over a special area in the die casting. Inserts also impart to it properties which it would not possess otherwise or to the same extent or within the same dimensions if they were not employed.

Aside from increased strength, such factors as greater toughness, decreased deflection under load, superior bearing properties, decreased use of metal, greater hardness or wear resistance, electrical or heat insulation and production in forms otherwise not available are among the considerations which the insert makes possible in various instances. These become apparent by reference

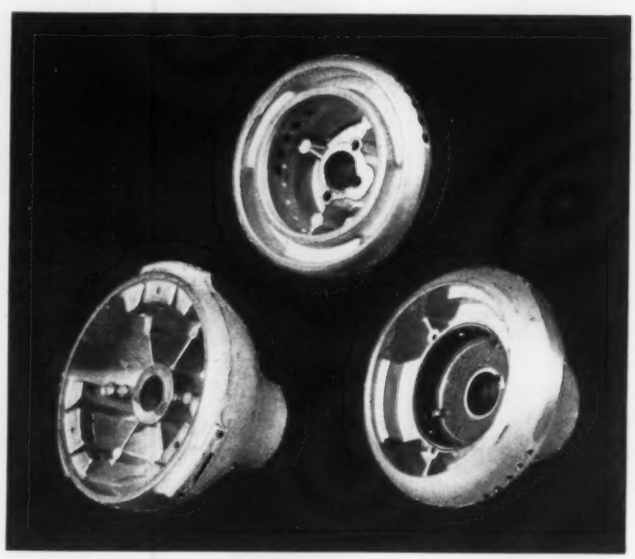


Fig. 2—Steel ring inserts facilitate manufacture of automobile steering wheel hubs

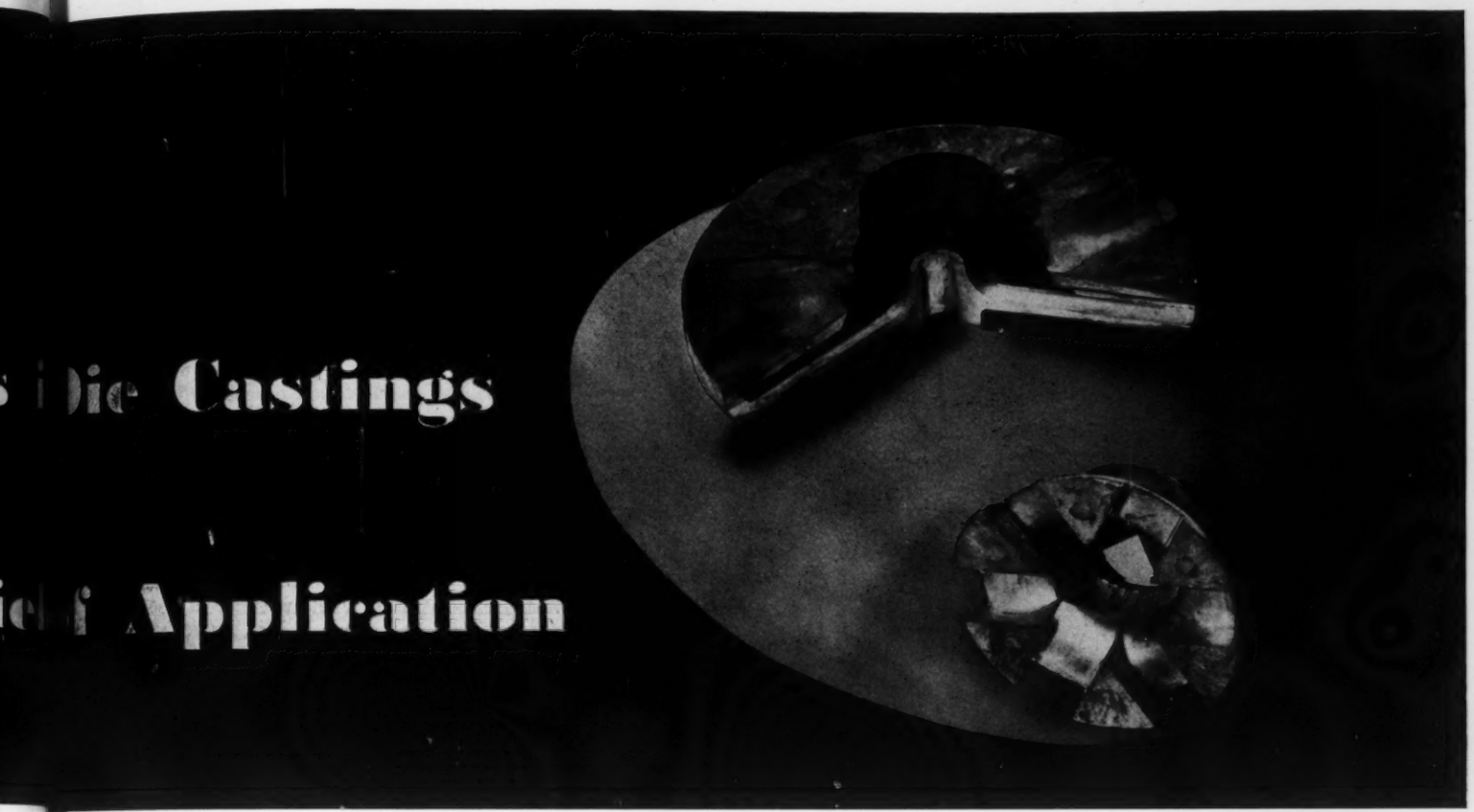


Fig. 4—Impeller is made of two die castings, one used as insert in other

to specific applications. Before considering these, however, some factors relating to the insert itself and the method by which it is applied may be mentioned.

The most common insert is the cast-in type. It is placed in the die and must be designed for positive positioning. This is necessary not only to assure correct location but to avoid the chance that the insert may jar loose and perhaps be caught between the halves of the die when it is closed with probable injury to the die or casting machine, or both. Positioning is usually accomplished by placing the insert over a core pin or inserting it in a hole or recess in which it is held securely. The portion entering such hole projects from the finished casting and, if desired, can be cut off subsequently. More often, the projection performs a useful function and may act as a means for fastening the die casting to a mating part.

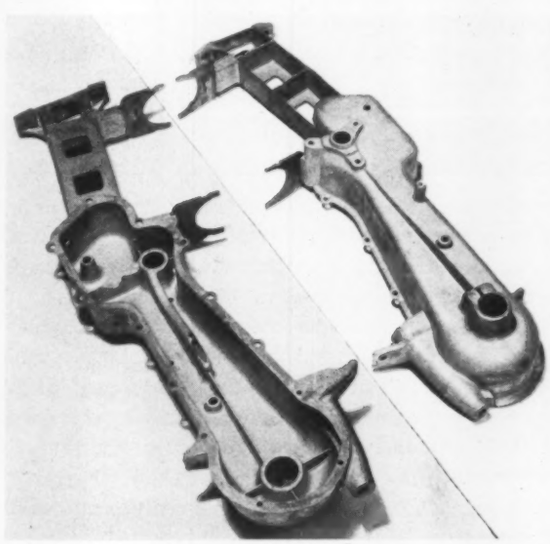


Fig. 3—Inserts of stamped steel project from die-cast gear housing to form motor mounting

It is quite possible and sometimes advantageous to apply certain inserts after casting. They can, for example, be pressed or threaded into cored holes or may be fastened by a nut, by riveting or even by spinning or crimping operations. The designer should not lose sight of such possibilities as they are sometimes less expensive and more satisfactory on other scores than cast-in inserts, especially if it is not essential to provide an anchorage quite so firm as that which results from casting the insert in place.

Projecting parts of inserts are sometimes threaded (they are often screw-machine products), but in any case they should be held within dimensional limits which the die caster will specify, as otherwise exact location is uncertain and the piece may be too large to enter the

hole provided or be too loose a fit in the hole. In addition, a loose fit may permit the molten metal, forced into the die under heavy pressure, to enter the hole and fill threads or other recesses which should remain open. This may make thread-chasing necessary or add needless expense otherwise. Incidentally, it is better to have threaded insert projections so made that the thread does not reach down to the die cavity, as the metal may follow the thread even though the pin is tight in the die hole and thus make chasing necessary. If the thread must come down to the body casting, it may be better to thread a stud into a cored hole subsequent to casting than to cast a stud in place. Holes are readily cored to tapping size, and tapping is inexpensive and may cost less than thread chasing.

Considering now some specific applications of inserts, that illustrated in the Bendix-Weiss universal joint, *Fig.* 1, is unusual yet suggestive of other applications never yet attempted. Basically, all universal joints

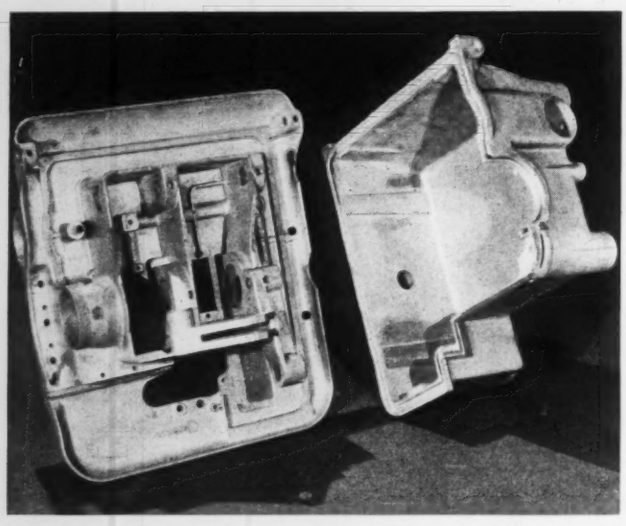


Fig. 5—Copper tubes to serve as oil ducts are die cast in place in this sewing machine housing

consist of a pair of yokes with some intervening member giving the universal action. In the joint in question, the intervening members are hardened balls which bear on hardened surfaces accurately ground to size, an arrangement which provides uniform angular velocity. the yokes proper are steel forgings, and the problem in production was to make them economically with the hardened ball races in correct location. Instead of making the races integral with the yokes, as in earlier designs (which involved expensive machining), the races are now made separately and quite simply and are then joined to the yokes and in correct position relative thereto, by die casting a matrix of zinc alloy between the yoke and races. This involves, of course, using the yoke and the races as accurately positioned inserts in making the die casting. In service, the forged yoke takes the bending and shock stresses and the hardened races the highly localized stresses of contact with the steel balls. The die-cast alloy, which is so disposed as to be loaded only in compression and is amply strong in this respect (at least 60,000 p. s. i. compressive strength), needs only to hold the inserts together. In this instance, the inserts may seem the more important parts of the assembly but, without die casting, the latter is not commercially producible at moderate cost.

Wrought Metals Are Tougher

Neither die-cast nor most other cast alloys have the toughness of wrought metals, but the zinc die-casting alloys are among the toughest of the common cast materials used for small parts (impact strength, 15 to 19 foot pounds Charpy, for standard ¼ inch square-section test specimens) and have a tensile strength of 36,000 to 47,000 p. s. i. and so are usable without inserts for a large proportion of applications. When the greater hardness and the strength and toughness of wrought metal are needed, their use as inserts performs many useful purposes.

Automobile steering wheel hubs, *Fig.* 2, are excellent examples of die castings in which several types of inserts are used. Such wheels are provided with stainless steel spokes which must be fastened to the hub. If the spokes were die cast as inserts, the finished casting could not be polished readily and would be bulky to ship to the fabricator who applies the rim. As a result, one method used to hold the spokes in the hub is to weld them to a steel insert. In the Ford hub, the steel ring to which the spokes are welded is cast into the hub. To prevent the zinc alloy from covering the inner surface of the insert and thus interfere with welding, the insert is forced as a press fit over the central core in the casting die. This slows the casting operation. A simpler way is to press a stamped steel cup into the casting after it is completed, insert the spokes so that they protrude through the side well of the cup and then weld them to this wall.

Bushings Die Cast as Inserts

Some of the die-casting alloys have sufficiently good bearing properties to permit reamed holes acting as bearings for light loads. But if more wear resistant bronze or other bushings are desired, these can be die cast as inserts quite readily. Either a bushing or an antifriction bearing can be inserted, of course, after casting by a pressed or free fit in a cored hole which is readily held within close limits. Bushings of porous bronze are inserted in the cored and reamed holes in the die-cast gear housing of the General Electric clothes washer seen in *Fig.* 3. Stamped steel U-shaped inserts which project from the casting form the standard motor mounting. Whether cast-in or inserted subsequently, however, the most machining of the bearing hole or bore that will probably be needed is a light reaming,

and even this is not required in some cases, as the pins serving as cores in the die are quite accurately located and leave a smooth accurate hole.

Among the light machines produced largely from die castings are vending machines, and many of these employ coin acceptance devices involving the use of a magnet. *Fig.* 6 shows how such a magnet is cast as an insert in one of the die castings used. The temperature attained it not sufficient to impair the properties of the magnet, and should a replacement ever be necessary the complete casting is substituted and assures a correct location for the magnet relative to the coin slot.

Die castings cool so rapidly that even wooden and pressed paper inserts are sometimes employed without any effect upon the wood or paper beyond a slight charring, hardly enough to discolor the surface. Inserts of this kind are employed to maintain a substantially uniform wall thickness on hollow castings which have a bulbous portion between two narrower necks. In such cases a metal core cannot be withdrawn if made the size of the bulb. An inexpensive wooden insert slipped over a core pin, which can be withdrawn through the neck, however, forms the interior of the bulb and remains inside the casting. This yields the uniform wall thickness and saves considerable metal otherwise necessary.

Plastics Suitable for Inserts

If a handle or part of a die casting to which heat should not be conducted requires insulating from some hotter part, the introduction of a plastic separator which is a relatively poor heat conductor may meet requirements. A plastic can be used as an insert without injuring it especially with the thermo-setting type of (phenolic) plastic. A similar arrangement of plastic insert will serve also as a dielectric separating die-cast metal parts. If the plastic is properly selected and applied, it can be cast in place without injury. Some die castings have also been used as inserts in molds so arranged that the molding compound is compressed into and cured in place inside the die casting, forming a dielectric core.

In contrast with this is the die casting of electrical conductors and heater wires as inserts. The latter has been done in the making of aluminum die castings for waffle irons, the wire being insulated in a heat-conducting dielectric element formed to the desired shape. Rotors for squirrel-cage motors have also been die cast with the shaft and laminations forming the inserts, as do also copper conductors when zinc is employed. Although the inserts are the basically important electrical and magnetic elements in these rotors, the die casting which holds them together forms a neat assembly, and the integral fan vanes also help to circulate air for keeping the motor cool. Field frames for small motors are also die cast with steel laminations used as inserts to form the magnetic circuit. Here again, the die-cast metal becomes a matrix for the inserts but also performs an important structural function and constitutes a simple way of making the required assembly.

In castings which require oil ducts, perhaps leading to a common well, arranged for lubrication from a single source, it is possible to cast in small pipes or tubes which, if necessary, can be bent in almost any fashion. The tubes, however, should have sufficient wall thickness to withstand the pressure applied in casting without collapsing. This pressure usually ranges from 500 to 2000 pounds per square inch. The ends of the tubes must also be so placed, of course, that molten metal cannot enter. *Fig.* 5 shows a sewing machine housing in which copper tubes, forming oil tubes, are die cast in place.

There are occasional cases of complex castings in which the insert itself is a die casting of the same metal as the alloy cast around it like the die-cast impeller for a centrifugal pump in *Fig.* 4. Such castings are employed when, for example, the coring required is such that, if made in one piece, the core could not be withdrawn. The first casting then includes a part of the core, a part which is withdrawn readily. This casting is then put in a second die as an insert and the remainder of the casting, including the remaining cored portion, is made. There must be provision for interlocking and for a sufficient section of metal at the joint, and also for preventing the flow of metal into the space cored in the insert, but these conditions are readily fulfilled where this method is applicable.

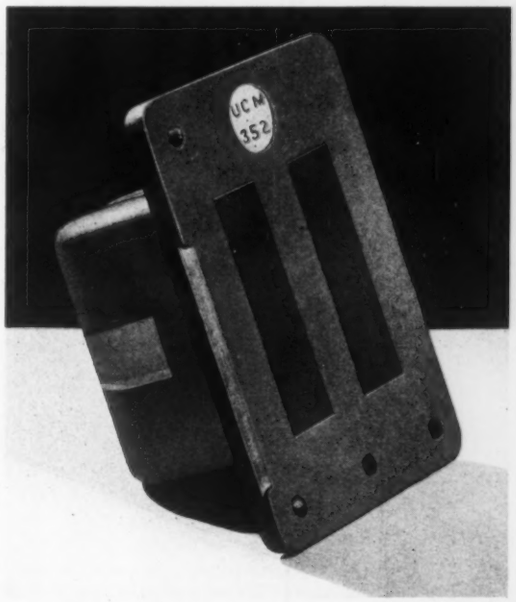


Fig. 6—Magnets are die cast as inserts in coin acceptance machine without impairing their properties

From the foregoing discussion, it is apparent that there are many cases in which inserts are used to great advantage and that they make possible a variety of construction which would not be feasible otherwise.

Fig. 1—Compactness is possible by placing transmission over axle

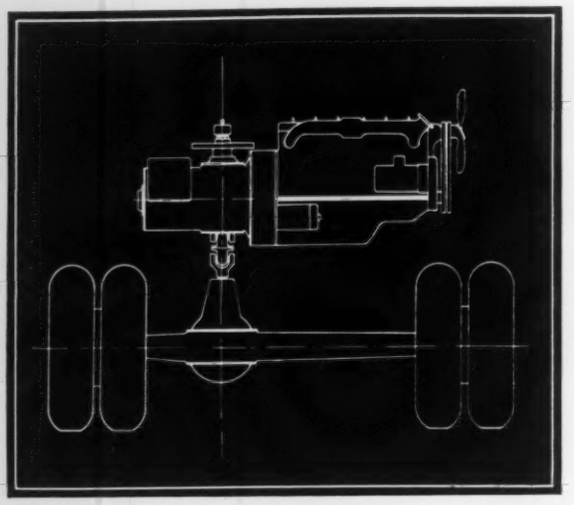
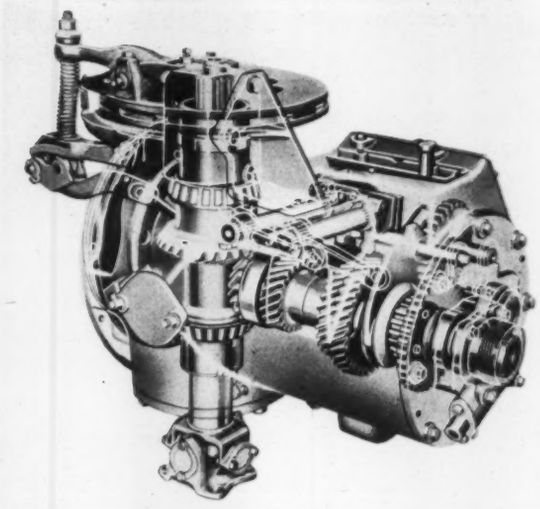


Fig. 2—Helical bevel gears transmit power at right angles from transmission to rear axle



Rear Engine Designs Reflect Engineering Skill

By C. D. Peterson

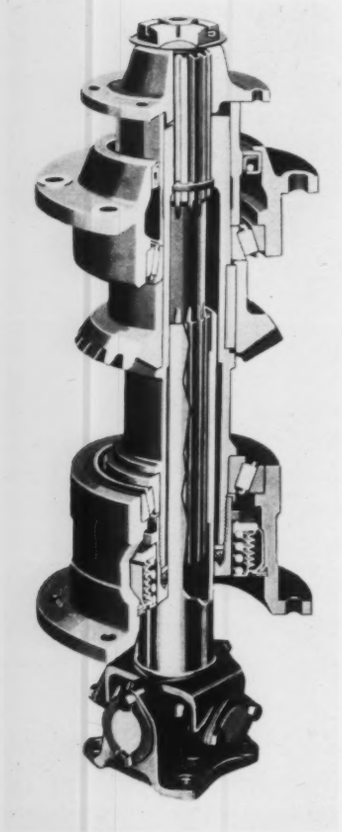


Fig. 3—Shaft is ingeniously sealed against oil leakage

ONE object in development of the coach in recent years has been to relocate the engine, in order to make a larger portion of the floor space available for pay load. The first step was to extend the body forward to include the engine. This still involved considerable loss of floor space, and led to the further step of putting the engine under the floor, and finally to setting the engine crosswise to the chassis and under the rear seat, thereby making practically 100 per cent of the floor space available for seating capacity and aisle space, while at the same time rendering the power unit more easily accessible as compared to any other engine location.

With the engine crosswise in the rear, rubber mounted and suitably insulated, the minimum amount of noise and vibration penetrates to the passenger compartment. The engine is accessible for checking or lubrication without disturbing passengers. Repairs are made without necessity of mechanics working in the passenger compartment to the detriment of the upholstery.

Road experience on ice has shown the advantage of the weight distribution attainable with rear engine location in regard to ease of control under all

IN all probability the next radical change in passenger automobile construction will be the placing of the engine in the rear. Already several coach manufacturers employ a rear-engined drive. In this article which is abstracted from a paper given at the annual meeting of the Society of Automotive Engineers, Mr. Peterson, of the Spicer Mfg. Co., discusses the design of several drives

conditions. The driver's position at the extreme forward end of the vehicle gives him maximum vision at all times.

There has been put forth many schemes of arrangement as regards the location of the engine and gear box in relation to the driving axle, but on account of unnecessary complications and large space requirements they were either discontinued after small quantities were manufactured or did not pass the experimental stage.

Three manufacturers are producing rear engined coaches in large quantities. Two of these place the transmission to the rear of or over the axle with transmission shafts, axle drive shafts and engine crankshaft parallel. One places the engine crankshaft parallel with axle drive shafts; however, the transmission shafts are at right angles to the engine crankshaft and axle drive shafts.

Indirect drive transmissions are employed by two coach manufacturers while direct drive transmissions are employed by one.

Fig. 1 gives diagrammatically a vertical drive arrangement. The transmission is placed substantially over the axle. The axle has a vertical input shaft, while the transmission has a telescoping, vertical output shaft. The transmission is put in driving connection with the axle through a constant velocity universal joint assembly. The transmission, axle and universal joint are so co-related that fight does not exist, due to varying position of the axle under chassis spring actions.

The engine and transmission are placed partially over the rear wheel house. This scheme requires the minimum space lengthwise of the coach. By this arrangement the wheel house can be placed within the engine compartment, eliminating it from the passenger compartment and thus making all seats equally comfortable to passengers.

Fig. 2 gives in cross section the vertical drive transmission. It is the indirect drive type, having three pairs of helical gears for forward speeds and spur gears for reverse. The overall gear ratio spread is 4.42 to 1 and with a low gear ratio of 4 to 1.

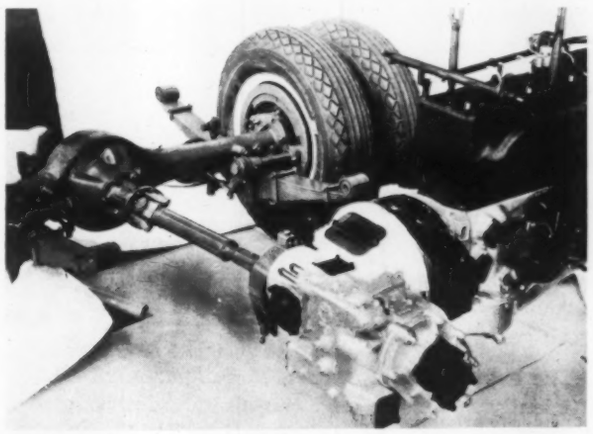


Fig. 4—Transmission primary shaft is at right angles to engine and axle shafts in this unusual arrangement

In each of the forward speeds, power is transmitted from the primary shaft to the secondary shaft through a single pair of helical gears, then through a pair of helical bevel gears to the axle. Sliding clutches put the gears of the different speeds in driving connection with the transmission shafts. A conventional remote control set, connected to the transmission control shaft through rods, is employed for changing speeds. A brake is mounted at the top of the vertical output shaft.

The vertical outlet shaft design shown in *Fig.* 3 is interesting in that it not only has to give both rotary and reciprocating motion, but must be thoroughly sealed against oil loss as the entire volume of oil in the transmission is above the seal.

A tubular, internally splined outlet sleeve integral with universal yoke and a splined, hollow shaft form the universal slip joint. The tubular sleeve and hollow shaft form a reservoir for the slip joint lubricant.

At the top of the outlet shaft is an expansion chamber which carries a ball check valve. On the up stroke

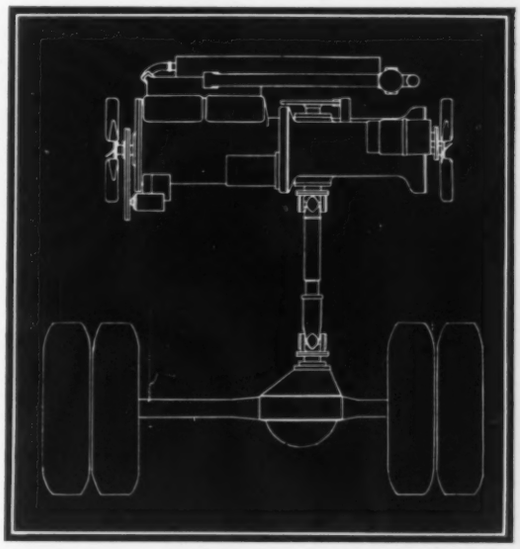


Fig. 5—Axle and transmission shafts are parallel in this type of rear-engine drive

of the slip joint, the ball check opens so that pressure is not built up in the slip joint chamber. Also, oil is transferred to the expansion chamber. Packings at the bottom of the outlet sleeve retain oil that spills over the sleeve.

On the down stroke the oil in the expansion chamber returns to the chamber in the slip joint. As the ball check closes a partial vacuum is created in the slip joint and oil that spills over the outlet sleeve is returned to the reservoir or held against escape. A single filling of oil lasts for long mileage.

The outlet shaft oil seal is a bellows type, spring load, metallic seal having a lead bronze nose piece working against a hardened, ground and polished steel member.

An arrangement that is used by one coach manu-

facturer that has proved extremely satisfactory is shown in *Fig.* 4. The engine crankshaft and driving axle shafts are parallel, while the transmission primary and secondary shafts are at right angles to engine crankshaft and axle driving shafts.

A pair of helical bevel gears with a mild reduction is placed between engine and transmission. The transmission is an indirect drive type employing single pair or helical gears for transmitting power from the primary to the secondary or output shafts in its three forward speeds. Spur gears are employed for reverse speed. The overall ratio spread is 3.82 to 1 with a low gear ratio of 3.79 to 1.

Sliding clutches are used for putting the gears in driving connection with the transmission shafts.

The transmission is manually controlled through a forward mounted, conventional remote control set and rods and levers connecting with the transmission shift rails.

Another right angle drive arrangement is shown

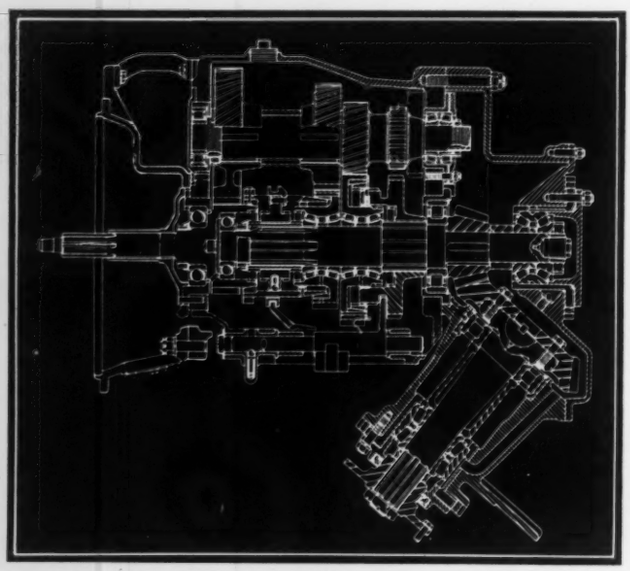


Fig. 7—Longer propeller shaft is possible with the angular outlet of this transmission

in *Fig.* 5 diagrammatically. The axle driving shafts and the transmission shafts are parallel and the transmission outlet shaft is at right angle to the transmission and axle shafts.

The transmission used in the coach employing the above arrangement is shown in *Fig.* 6, which is an indirect drive transmission with single pairs of helical gears transmitting power from the primary shaft to the helical bevel gear driven outlet shaft in all three forward speeds. Spur gears are employed for reverse speed. The gears are put in driving connection with the shafts by sliding clutches. A forward mounted conventional remote control is connected to the transmission shift shafts by rods and levers for changing speeds.

The clutch is placed on the opposite end of the trans-

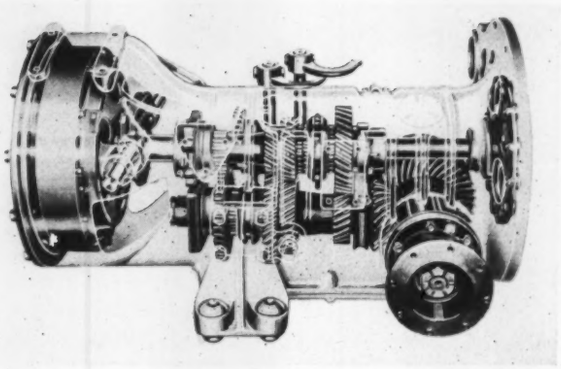


Fig. 6 — Sliding clutches place gears in driving connection in transmission, which has a right angle power take-off

mission than the engine. A quill shaft is employed to transmit power from the engine to the clutch which, in turn, transmits it to the hollow primary shaft of the transmission. This location for the clutch makes it extremely accessible for servicing.

With the clutch so located it is away from engine heat and permits good ventilation.

The transmission in *Fig.* 7 permits the engine to be located close to axle and employs a longer propeller shaft than in a right-angle drive. It is a three-speed, helical gear, direct drive type transmission having inertia lockout type synchronizers for all forward speeds. Reverse is through spur gears non-synchronized. Power is transmitted from the transmission to the driving axle through a pair of helical bevel gears carried in the angular outlet housing at the rear of the transmission case.

The transmission is power-shifted by a Bendix-Westinghouse pneumatic gear shifting system, through which the clutch also is operated. Transmission and clutch control are interlocked and automatic in action so that the clutch is fully disengaged before a speed change can be made and a speed change must be completed before the clutch is engaged.

This same transmission is manually operated when power shifting is not used, which is accomplished by a forward mounted, conventional remote control connected to the transmission through rods and levers to a control tower carried on the transmission.

The transmission carries the following ratios: High 1 to 1; second 1.74 to 1; first 3.32 to 1; reverse 3.41 to 1.

All the foregoing transmissions have three forward speeds and are used mostly for city service. The gears of all transmissions used in coaches are case hardened, and the helical and spur gears have their teeth generated ground.

The engine and transmission compartment should be efficiently ventilated and the air circulation such that operating temperatures of the transmission should not

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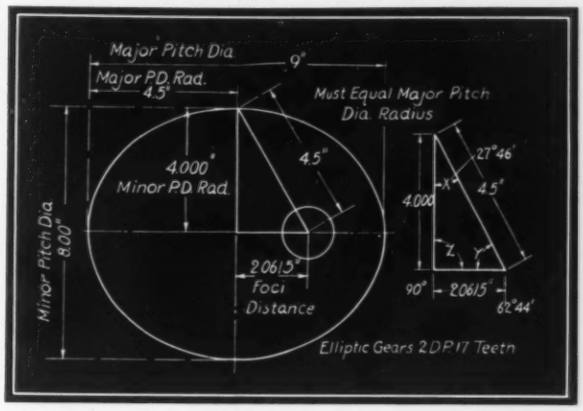


Fig. 1—Basic trigonometric functions are used to calculate pitch diameters for elliptical gears

Elliptical Gears

Depend on Accurate Layout

By Edward J. Rantsch

ALTHOUGH the subject of elliptical gearing is an old one, it is not understood thoroughly by the majority of designers and engineers. This is due, principally, to the lack of information and practical working data which, up to the present time, have never been published in such form as to be usable and suitable for making necessary calculations. While it is true that it is impossible to make theoretically correct elliptical gears, nevertheless it is possible to make them nearly so in practice.

As the pitch circle is always of ever-changing curvature in elliptical gears, some of the working data are actually measured from carefully made layouts, using gold lacquered tin-plate and scribing all lines very carefully. Measurements are then taken of the layout and the values inserted in their proper places on the shop drawings.

Articles on this subject have appeared from time to time, but not in a form that would be of much assistance to the reader, leaving too much for imagination. Therefore, a typical case will be chosen and carried through to the finished gear.

To construct our layout as the first step in the design and calculation of elliptical gears, I have used a diametral pitch of 2, 17 teeth, and a major pitch diameter of 9 inches, to give a quick return ratio of 2 9/13 to 1 per gear. Therefore, in finding the foci distance to give this ratio, we get 2 9/13 or 35/13, and 1 = 13/13, or a total of 35/13 + 13/13 = 48/13. The major pitch diameter divided by 48 = 1/13, or 9/48 = .1875 inch, and .1875 inch × 35 = 6.5625 inches; then as the major pitch diameter radius equals 9/2 or 4.5 inches, we have for our foci distance 6.5625 inches — 4.5 inches = 2.0625 inches. (Mention is here made that the foci distance is arbitrarily changed from 2.0625 inches to 2.0615 inches, a difference of .001 inch, in order to have the perimeter correct for the number of teeth and circular pitch.)

By referring to *Fig.* 1, we see that in order to find the minor pitch diameter, it is first necessary to calculate the triangle as shown at the right. As noted, we must follow the rule that the hypotenuse is equal to the major pitch radius or 4.5 inches, and as we now have two sides of the triangle given, namely, 4.5 inches and 2.0615 inches, we find by trigonometry that the remaining side equals 4 inches. Therefore, the minor pitch radius equals 4 inches, and accordingly the minor pitch diameter equals 8 inches.

Having our major and minor pitch diameters, we

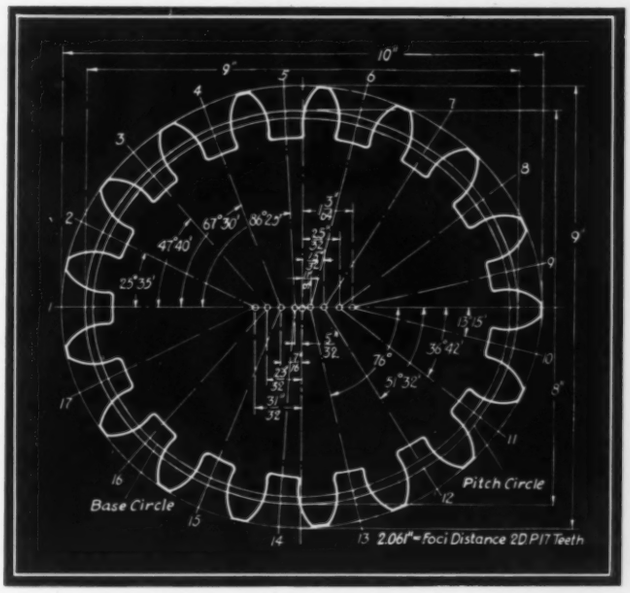


Fig. 2—Several centers, as shown on the layout, must be used to cut the teeth for an elliptical gear

now calculate the *perimeter* of the pitch circle. There are several formulas for this, but the following one has been found satisfactory.

(2 × Major Pitch Dia.) +
.7854 (2 × Minor Pitch Dia.) = Perimeter

Then 2 × 9 = 18, and 2 × 8 = 16. Adding, we get 34, and 34 × .7854 = 26.7036 inches for the perimeter of the pitch circle. Dividing 26.7036 inches by 17, the number of teeth, we find our circular pitch equals 1.5708 inches. This corresponds to a diametral pitch of 2 as stated, and is therefore correct. Several trials may be necessary in order to have results work out as in the foregoing.

In making the layout the major and minor outside diameters are calculated the same as for spur gears and equal 10 and 9 inches respectively. The base, working depth, and full depth circles are calculated the same as spur gears using the minor diameters for this calculation. The curvature of the teeth (14½ degree pressure angle being used here) equals a radius of ¼

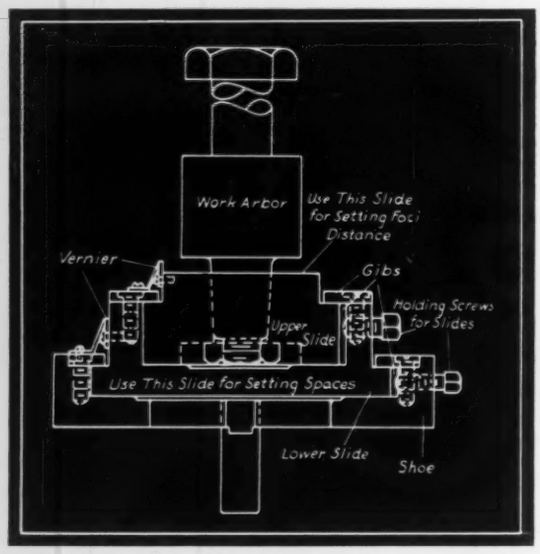


Fig. 3—Special milling fixture is required to cut elliptical gear teeth

the minor pitch radius, 1 inch in this case. See *Fig.* 2.

The use of gold lacquered tin-plate facilitates the laying out of the templet. Horizontal and vertical center lines are drawn as shown in *Fig.* 2, the foci distance of 2.0615 inches is marked off, and then with a suitable ellipseograph the outside, pitch, base, working depth and full depth circles are drawn. With a space at one end, and a tooth at the other end of the major pitch diameter, the dividers are set for 17 teeth in the gear, which are then stepped off equally around the pitch circle. It is necessary to do this twice in order that both sides of the teeth will be located. The dividers are now set to a 1 inch radius, and with one leg on the base circle, the tooth arcs are drawn as shown, intersecting the positions marked off on the pitch circle. When this has also been done twice around, fillets at the bottom of the teeth are drawn and the tooth contour formed.

It is now necessary to proceed with the data required in spacing and cutting the teeth in the shop. It will be noted in *Fig.* 2 that center lines have been drawn through all the spaces in the gear, meeting the horizontal center line. This must be done carefully, because it is here that calculations cease and measurements must be taken. By referring to *Fig.* 2, one will note that the amounts off center are clearly marked. Also, the angular positions of the spaces made from the horizontal center line are drawn in and measured. Referring to the amount off center such as 31/32 inch, it will be seen that this is the amount to move the milling fixture slide off center to create a new center in milling spaces Nos. 2 and 17. The angular positions for these spaces will be 25 degrees 35 minutes from the horizontal center line of the gear blank. This procedure is followed for the next two spaces and then followed until all the spaces are completed. The layout is now in the form required by the shop mechanic and the next problem is to prepare the gear blank for cutting the teeth. The distance between the shafts will be equal to the major pitch diameter or 9-inch centers.

In preparing the gear blanks it is necessary to face both sides of the blanks and bore the shaft hole, after which an oval turning fixture is required. The work is mounted on a stud on the face-plate and the fixture is set off center to an amount one-half the difference between the major and minor diameters. In turning, the tool point must be set to the height of the center of the spindle and should be done with a special height gage which will insure accurate results.

Cutting the teeth requires a special milling fixture with vernier reading, as shown in *Fig.* 3, and a circular milling attachment graduated in degrees with vernier reading to five minutes. The bottom of this fixture has a plug for centralizing it on the circular milling attachment. Selection of the cutter should be for the minor pitch diameter or 8 inches. As the diametral pitch is 2, we have 8 × 2 = 16 teeth. The spaces should be cut .003 inch deeper than regular depth or 1.079 inches + .003 inch = 1.082 inches in order to take care of any slight variations in tooth thickness; a small amount of backlash between teeth will not be objectionable.

The gear blank is now mounted on the fixture with the horizontal center line, inscribed in the oval turning fixture, parallel to the slide movement of the fixture. In this position the circular milling attachment should also read zero and we are ready to cut space No. 1 For each space it is necessary to make an adjustment of the slide of the milling fixture to correspond with its own center which is shown on the layout, *Fig.* 2.

Most important, of course, is the layout which must be done with precision and accuracy, but unless one continues this precision in the mechanical cutting of the gear the results will not be satisfactory. If all settings have been made correctly on the milling fixture the gear should be accurate in every detail.

Product Design Trend Influences Development of Machine

NEVER more than a few steps behind the latest mode in manufactured products is the machine designer who, with his mechanical ingenuity, is able to crystallize practically and economically the concepts of inventors and stylists. If generals want guns that will hurl two-ton projectiles 70 miles the machine designer creates them for him; if automobile designers conceive a seamless all steel top for their cars, the machine designer produces a press that will stamp out these tops as easily as earlier machines stamped out hub caps.

Popular demand at present is causing automobiles, trains, and a multitude of other mechanical products to be styled in flowing contours without which they cannot be considered modern. Furniture makers have realized this and a glance at any modern piece will reveal edges and corners with sweeping, graceful lines. But bending or shaping a piece of heavy oak plank is not the comparatively simple task it is for sheet

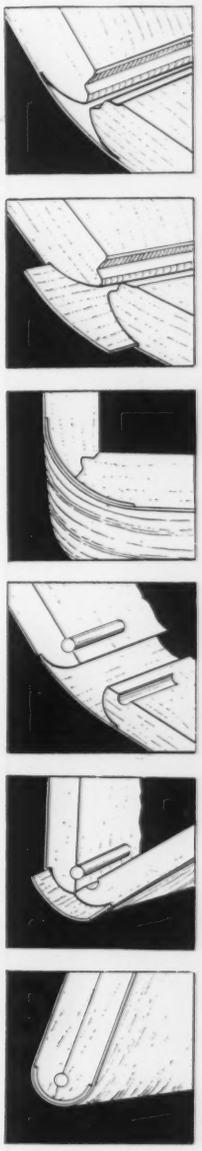


Fig. 1—Method in which panels are cut to make 90- and 180-degree bends without breaking outer surface of wood are shown above

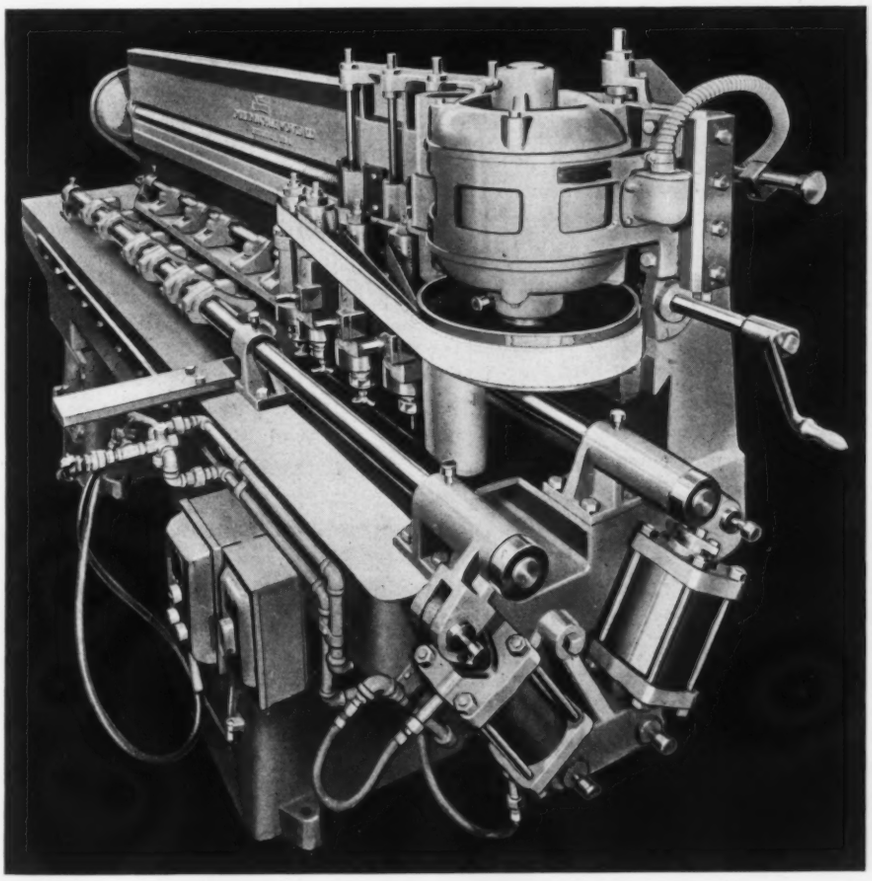


Fig. 2—Four spindles driven from single pulley are an unusual feature of the round corner router

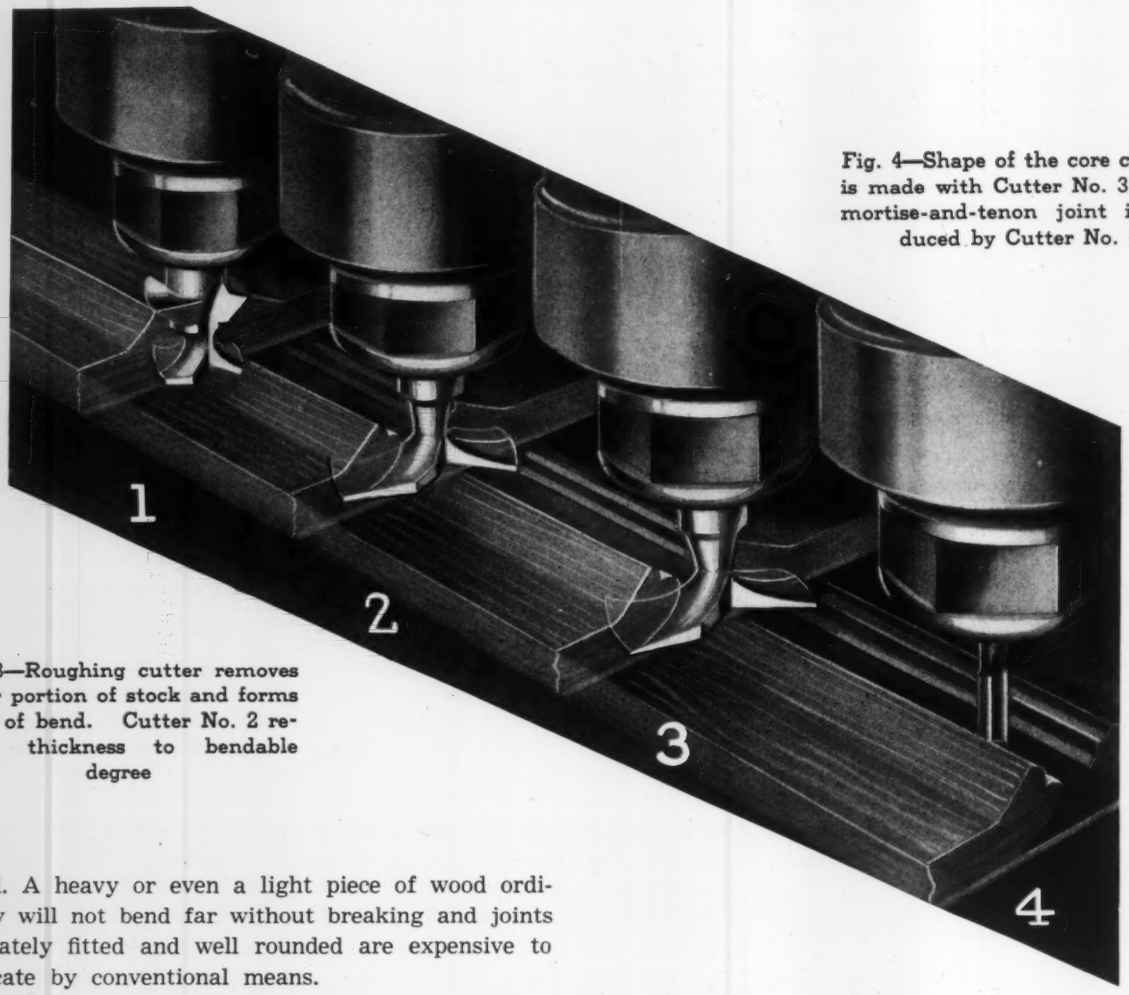


Fig. 4—Shape of the core contour is made with Cutter No. 3, while mortise-and-tenon joint is produced by Cutter No. 4

Fig. 3—Roughing cutter removes major portion of stock and forms angle of bend. Cutter No. 2 reduces thickness to bendable degree

metal. A heavy or even a light piece of wood ordinarily will not bend far without breaking and joints accurately fitted and well rounded are expensive to fabricate by conventional means.

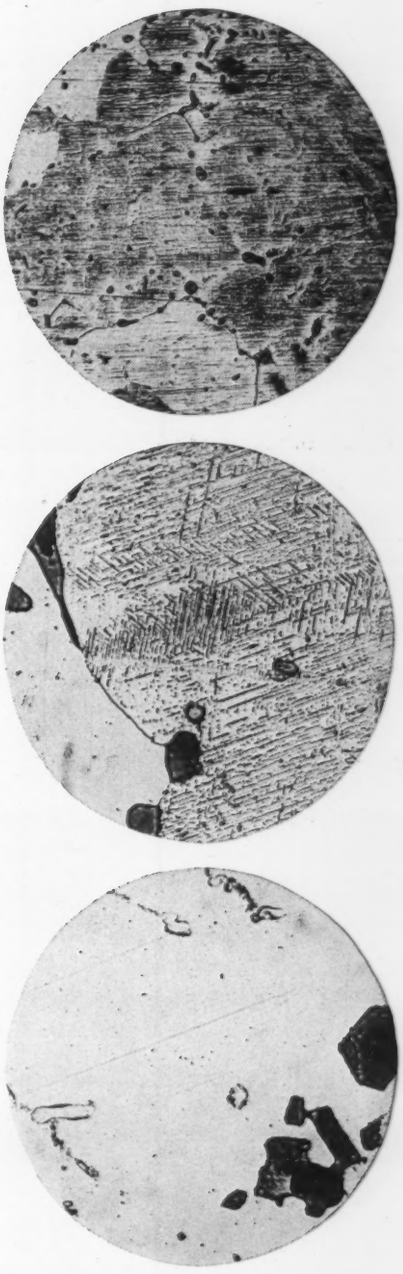
Now a new method in woodworking practice has appeared. Wood sections may be bent up to 180 degrees without a break on the surface after preparation on a high speed machine developed by Onsrud Machine Works Inc. *Fig.* 2 shows the complete machine with four-in-line spindles which cut the wood stock to a unique tongue-and-groove shape shown in *Fig.* 1. Not only have the four machining operations, shown in *Figs.* 3 and 4, been combined in one compact machine, but also all spindles are run at 14,000 revolutions per minute by the same 7½ horsepower motor. Four flat belts, one over the other, drive the different cutting spindles from one large motor pulley. The spindle heads and motor move over the work as a complete unit by a motor driven screw, feed being regulated according to the wood being cut. The feed motor is reversible.

Designed for high speed production, the round corner router employs pneumatically actuated clamps to hold the work in place while it is being cut. Twelve elastic shoes, six on each side of the work, have a combined pressure of 2400 pounds from two air-operated cylinders which can be seen in *Fig.* 2. The cutter carriage is automatically stopped at the end of the cut by coming in contact with an adjustable stop and the carriage returns at twice the speed it traveled during the cutting operation. Both ends of the machine bed are open, permitting any length of stock to be placed on it, and provision is made for attachment of an auxiliary support for long stock. Panels from ½ to 2 inches thick and up to 60 inches wide can be handled.

Action of the four spindles in preparing the wood is clear in *Figs.* 3 and 4. No. 1 is a roughing cutter which removes the major portion of the stock and forms the angle of the bend. Nos. 2 and 3 produce the thin bendable surface and shape the contour. One of the tenons is removed by No. 4, a self-centering mortise-and-tenon then being formed insuring a smooth flowing surface when the inner edges are butted in the process of bending. Different degrees of angles and radii of bend are produced by correspondingly different sets of cutters. The method in which 90 and 180-degree bends are cut, glued and finished is shown in *Fig.* 1.

This round corner router is designed for easy control by one operator, controls for cutter, feed motors and air actuated clamps all being within easy reach. Two graduated stops are provided on the bed, which center the work correctly. Suitable adjustments are built into the machine to align cutter motor with spindle driving belts.

Casting Refinement Widens Scope of Stainless Steel



STAINLESS steels which for some time have proved an invaluable ally of the machine designer now enter a new era of usefulness with the refinement of the stainless steel casting. Until recently stainless alloys were used principally in the form of sheet and bar stock while castings, due to price and inferior quality, were relegated to a position of secondary importance.

The pressing need, however, for economical castings of stainless steel free from defects has spurred metallurgists and foundrymen in research which recently has resulted in an improved process producing superior steel. Refinement in stainless and heat resisting castings is now being accomplished by the melting of the metal in a hollow electrode furnace developed by the Ludlum Steel Co. Innumerable castings have already been turned out which have met consumers' demands and satisfied the exacting specifications of metallurgical engineers. *Fig.* 3 shows samples of parts that have been cast.

The hollow electrode furnace is 'an indirect arc type with rotating,

Fig. 1—Top and Center—As-cast condition of 18-8. Etchant aqua regia glycerine to show average structure and type of inclusions, which include chrome oxide and silicates. Top 100X, center 500X. Bottom—As-cast condition, etchant sulphuric acid plus potassium permanganate, washed with oxalic acid, to show chrome oxide, 500X

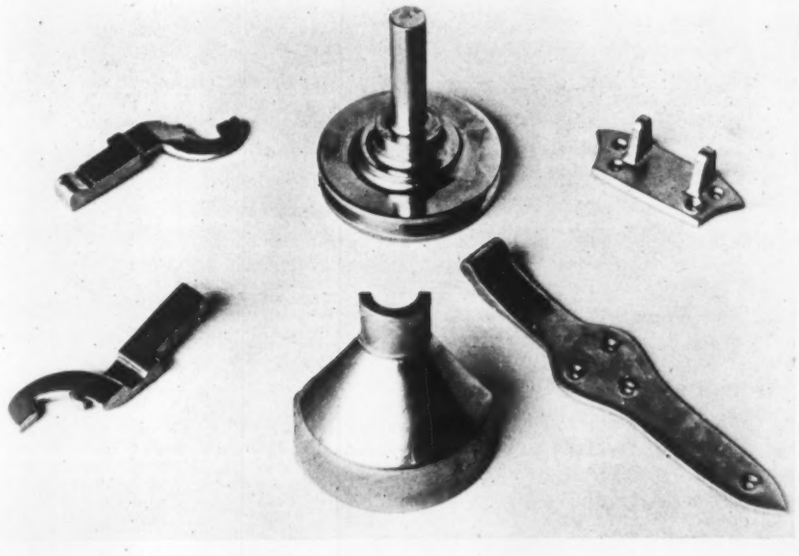


Fig. 2—High polish has been obtained on these stainless steel parts although the castings have not been machined

TABLE I

Machining Tests

Steel C.	Steel Cr.	Steel N.	State	Machining Operation	Type Tool	S.F.M.	Feed	Depth of Cut, Inches	Remarks
0.17	18.04	7.64	As-cast	Turning	18-4-1 HS.	140	1¼" per min.	0.06	Surface smooth. No porosity nor sand spots. Tool O.K.
0.11	18.88	7.64	As-cast	Turning	7% Co. HS.	127	0.015"	0.025	Surface good. No porosity. No sand holes. Tool O.K.
0.11	18.88	7.64	As-cast	Drilling	H.S. ½" R.J.	55	1⅜" per min.		Drill O.K. Surface holes smooth. Clean. No porosity. No sand holes.
0.17	18.66	8.07	As-cast	Turning	7% Co. HS.	104	0.010"	0.013	Surface good. No porosity. No sand holes. Tool O.K.
0.17	18.66	8.07	As-cast	Drilling	H.S. ½" Rd.	55	1⅜" per min.		Drill O.K. Surface holes smooth, clean. No porosity. No sand holes.
0.19	19.01	29.29	As-cast	Turning	18-4-1 HS.	69	0.030"	1/16	Tool O.K. Finish good. No porosity. No sand holes.
0.19	19.01	29.29	As-forged	Turning	18-4-1 HS.	76	0.020"	1/32	Tool O.K. Finish good. No porosity.
0.11	19.68	9.99	As-cast	Turning	18-4-1 HS.	69	0.005"	1/32	Tool O.K. Finish good. No porosity. No sand holes.
0.11	19.68	9.99	As-forged	Turning	18-4-1 HS.	107	0.030"	1/16	Tool O.K. Finish smooth. No porosity.

hollow, horizontal graphite electrodes, slightly inclined towards the arc to permit the reagent placed in the electrodes to flow freely from the arc ends. The arc impinges on the bath, but the bath does not become part of the arc circuit. The interior of the furnace is 72 inches in diameter and will produce heats from 1000 to 6000 pounds. Thus, the essential feature of the furnace is the use of hollow electrodes. These rotate at a very slow speed to insure an even wear of the arc ends, and permit the production of refining reagents by means of smelting ores and carbon within them during the melting and refining of the bath.

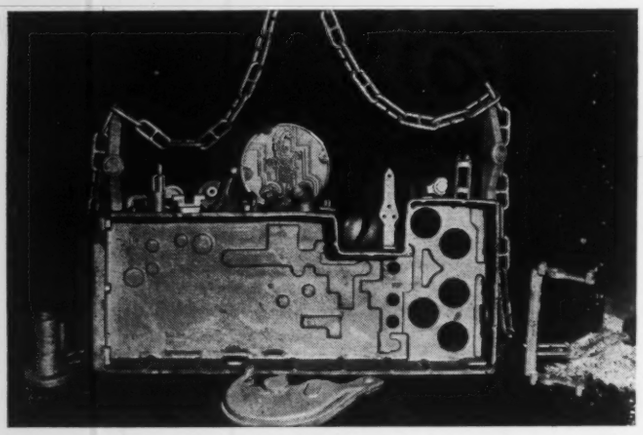


Fig. 3—A sundry variety of castings are possible with stainless steels made in the hollow electrode furnace

Of particular interest to the designer of machines is the increased machinability of the steel. This has been accomplished by the dispersion of chromium oxide throughout the bath which results in the retention of inclusions in the stainless steel. These inclusions not only increase the machinability of the casting but do not affect its corrosion-resistant property deleteriously and also cause some ductility in the event that the steel is to be forged. Evidences of the fact that stainless steel castings made from metal produced in the hollow electrode furnace, especially when there has been no attempt made to eliminate the oxides of chromium from the bath, possess good machining characteristics are shown in Table 1.

Porosity which has plagued efforts in the past to produce stainless steel castings is now almost entirely absent which is due, it is believed, to the excessive oxidizing of the bath with chromium oxide, the continual removal of all furnace gases, and by the constant and easy maintenance of high pouring temperatures. The completely gas-free metal pours quickly and consequently with less tendency to cut sand molds, resulting in cleaner castings.

Samples from various heats subjected to 20 per cent salt spray tests at room temperature for periods up to 72 hours have shown splendid resistance to corrosive attack. This is true not only when the samples were in the as-cast state, but after heat treatment and forging as well. Rusting, pitting or anodic type of corrosive attack have not been discernible on samples which have been exposed to atmospheric conditions over a period of 13 months.

Intergranular corrosion tests using copper sulphate and sulphuric acid solutions have demonstrated that the 18-8 types of steel made in the electric furnace are about equal to commercial 18-8 hot rolled or forged steels, providing that the castings are given heat treatments, usually air or water quenching from 1850 to 1950 degrees Fahr. There is certainly no question but

TABLE II

Tensile Tests

Steel C.	Steel Cr.	Steel Ni.	State	Temp. Test, degrees Fahr.	Proportional Limit Lbs./sq. in.	Yield Point Lbs./sq. in.	Tensile Strength Lbs./sq. in.	Elongation % 2"	Red. of Area %	Brinell Hardness
0.17	18.04	7.64	As-cast	70	22,500	31,500	36,500	3.5	15.2	159
0.18	19.01	29.29	As-cast	70	20,000	29,000	67,250	20.5	22.3	131
0.18	19.01	29.29	As-cast	1700	—	16,150	16,850	19.0	26.4	—
0.11	19.68	9.99	As-cast	70	12,500	26,500	69,500	41.0	37.2	140
0.18	19.01	29.29	Forged	70	13,500	53,500	93,500	22.0	17.7	207
0.18	19.01	29.29	Forged	1700	—	—	22,750	16.0	45.4	—
0.11	19.68	9.99	Forged	70	52,500	71,000	97,000	38.5	49.1	196
0.11	19.68	9.99	Forged-Treated 1850°F. Air cooled	70	16,000	31,500	84,750	53.0	57.0	—

that the freedom from porosity and sand spots in the castings made from stainless steels melted in the hollow electrode furnace have been distinctly favorable from the standpoint of resistance to corrosive attack.

Typical tensile tests made on stainless steel castings in the as-cast condition as well as after some forging work from metal made in the hollow electrode furnace are shown in Table II.

Grain structure with inclusions are shown in *Fig.* 1 magnified at 100 and 500 diameters. The types of inclusions that have been found most prominently in the stainless steels produced in the hollow electrode furnace have been (a) the brittle, refractory, non-malleable chrome oxide; (b) another type of chrome oxide not precisely identified, and (c) silicates sometimes entrapping iron sulphide which type of segregate possesses good malleability at forging temperatures and often tends to form envelopes around dendritic areas especially near the feeder points of the casting.

The practical and economic use of stainless steels in castings will undoubtedly be applied advantageously by the designing engineer in machines. Wherever corrosion resistance, finish, appearance and freedom from contamination, as in food handling machinery, are necessary stainless steels have found a wide field and in the form of castings will be utilized even more.

Rear Engine Designs Reflect Engineering Skill

(*Continued from Page* 42)

be raised above that normally experienced from friction and fluid friction.

Due to the short length of propeller shaft inherent in rear engine location when driving to rear axle, a problem arises due to the stiffness or torsional rigidity of the drive line when the conventional type of tubular propeller shaft is used. Due to this rigidity the effect of shock loading is very greatly increased. One simple solution for this difficulty is to use a solid propeller shaft with a long, polished, reduced section to give the desired flexibility. This is made possible by the short length of the shaft in which whipping of the shaft is not a problem.

On the quill type of transmission the same feature has been carried out by reducing and polishing a considerable section of the through shaft. Suitable material and heat treatment has to be applied, of course in the design and manufacture of these solid shafts.

Another very beneficial result of the flexibility introduced in the drive line in this manner has been the effect on noise due to torsional vibration transmitted into the drive system from the engine at certain speeds. This cushioning or flexibility has had a dampening effect, greatly reducing the amount of this roughness or noise.

Welding Prizes Offered To Designers

PRIZES amounting to $200,000 will be awarded by the newly-created James F. Lincoln Arc Welding Foundation to the winners of 446 separate prizes for papers dealing with arc welding as a primary process of manufacture, fabrication or construction in 11 major divisions of industry.

Machine designers will be especially interested in the competition as most of the prizes cover fields with which they are intimately connected. With arc welding making new strides daily in machine construction many designers will be able to apply to their own machines the results of research and the trends in design as disclosed by the competition.

The principal prize winner will receive not less than $13,700 while other prizes range from $7500 to $100, the latter sum to be awarded to 178 contestants who receive no other prize but whose papers are adjudged worthy of honorable mention. When accepted by the jury of awards as properly classified, each paper will be in competition, in its particular sub-classification, for five initial prizes established in that group. These are worth, respectively, $700, $500, $300, $200 and $150. Further competition will place the papers in the semi-final and final competitions with additional prizes in each elimination.

Awards in the fields directly related to the machine designer are as follows:

Automotive, 24 prizes with a total value of $14,200; sub-classifications, engines, bodies, frames and trailers.

Aircraft, 14 prizes with total value of $10,500; sub-classifications, engines and fuselages.

Railroad, 24 prizes with a total value of $14,200; sub-classifications, locomotives, freight cars, passenger cars, car and locomotive parts.

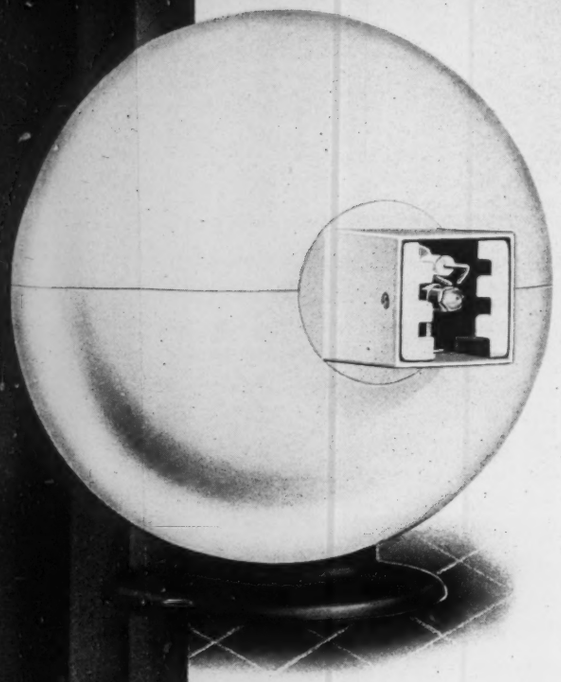
Watercraft, 14 prizes with total value of $10,500; sub-classifications, commercial and pleasure.

Functional machinery, 54 prizes with a total value of $25,300; sub-classifications, metal cutting, metal forming, electrical, prime movers, conveying, pumps and compressors, business, jigs and fixtures, parts, and not otherwise classified.

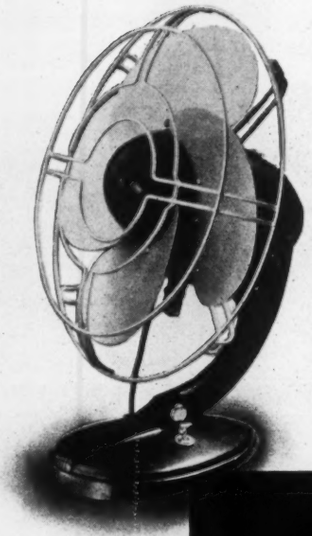
Industrial machinery, 54 prizes with a total value of $25,300; sub-classifications, process, construction, petroleum, steel making, farming, household, food making, textile and clothing, printing and not otherwise classified.

Other fields the awards will cover are structural, furniture and fixtures, welderies, and containers.

Contestants, it is announced, must have papers in duplicate on file with the secretary of the Foundation not later than June 1, 1938. Prospective entrants should communicate with the Foundation secretary, A. F. Davis, Box 5728, Cleveland, for complete details and rules governing awards.



Completely enclosed in a colorful, spherical shell, the new S-K oil burner, left, is protected against dust and dirt and adds appearance to a heating unit. A 1/6 - horsepower motor, mounted on rubber, drives the cast aluminum blower wheel and is shielded to prevent radio interference.

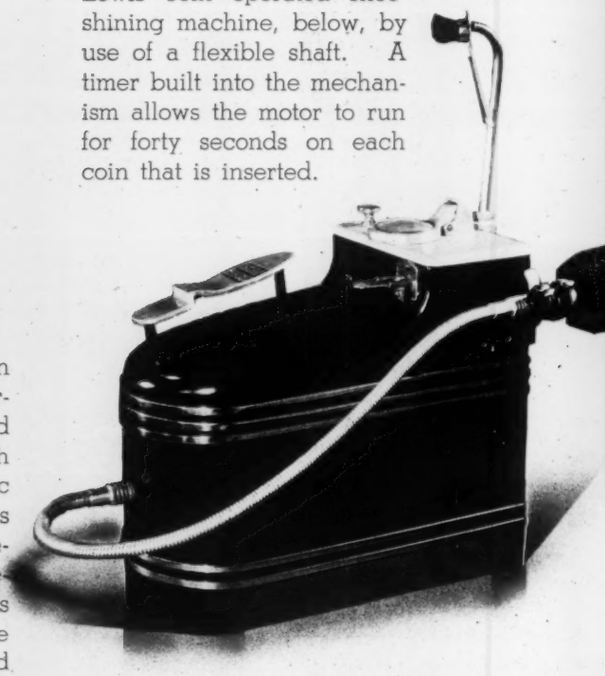


One-piece, die-cast rounded contour motor shell entirely encloses oscillating mechanism in the Gilbert fan, left. Four brightly finished aluminum blades of special curvature permit more air with less noise, and oil impregnated bronze bearings give long life.

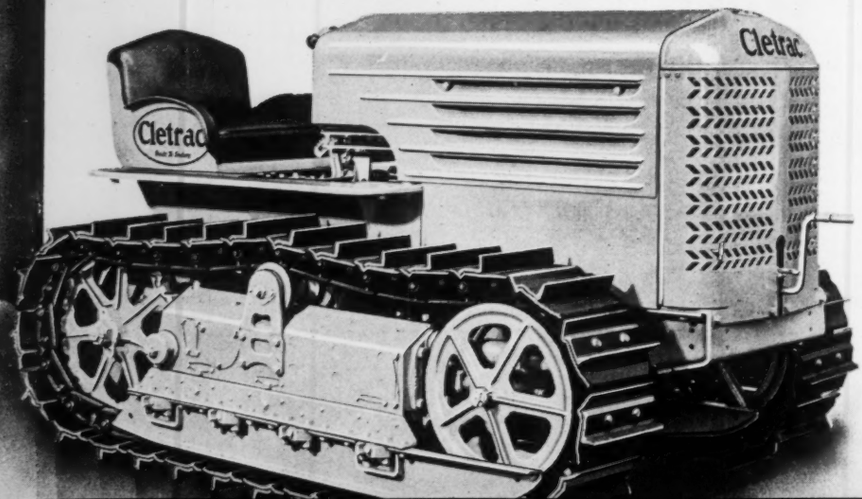
Design Fe
in New Mo

A Pictorial Presentation of
from the Standpoint

Ease of handling is accomplished in the Gibb-Lewis coin operated shoe-shining machine, below, by use of a flexible shaft. A timer built into the mechanism allows the motor to run for forty seconds on each coin that is inserted.

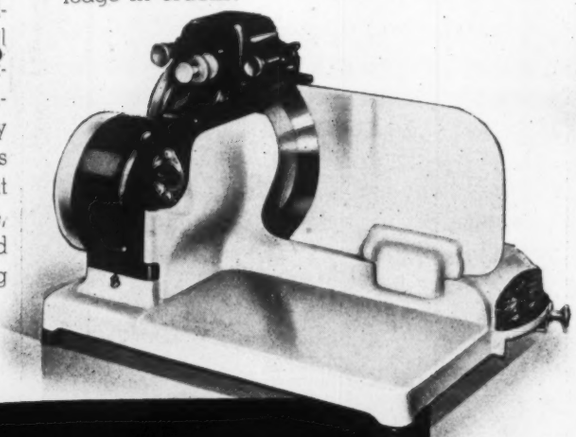


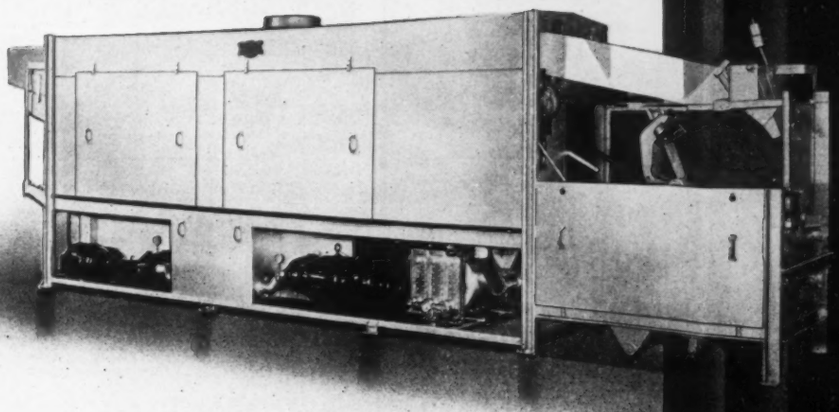
Corners rounded in streamline design, steering easily accomplished with power in both tracks, the new Cletrac tractor, below, looks and operates like a precision machine. One-piece, drop-forged shoes used in the tracks are differentially quenched making them exceedingly tough.



Enclosure of the belt and drive mechanism on the Delta belt surfacer, right, not only is a safety feature but serves as an efficient dust-collecting system. The machine may also be used as either a horizontal or vertical sanding machine for wooden parts.

Quiet operation is assured in the Hobart slicing machine, below, by the use of a Bakelite drive gear meshing with a polished steel pinion. All exposed metal parts are constructed of stainless steel or alumilite and are precisely fitted so that food particles cannot lodge in cracks.

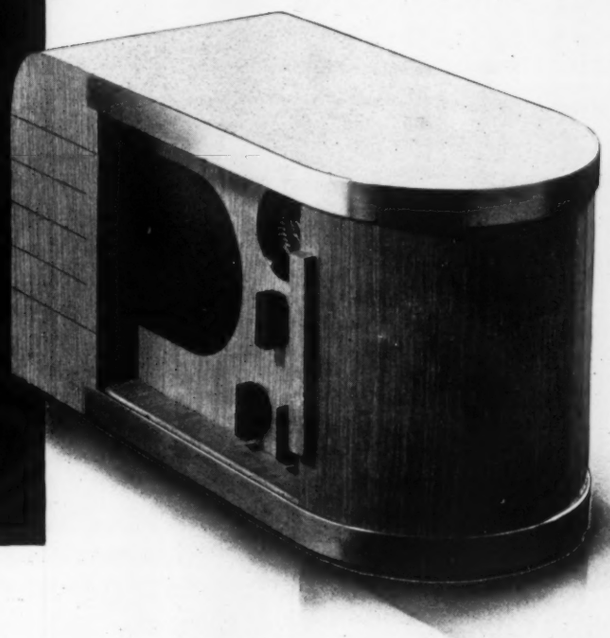




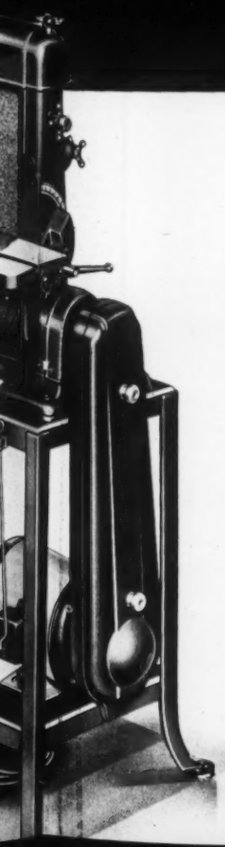
Cans or containers being washed automatically actuate steam and water jets in the Creamery Package washing machine, above. Ground seat unions are used to eliminate the need for gaskets and ball bearing centrifugal pumps supply steam and water pressure. A geared-head motor operates the machine.

Features Machines

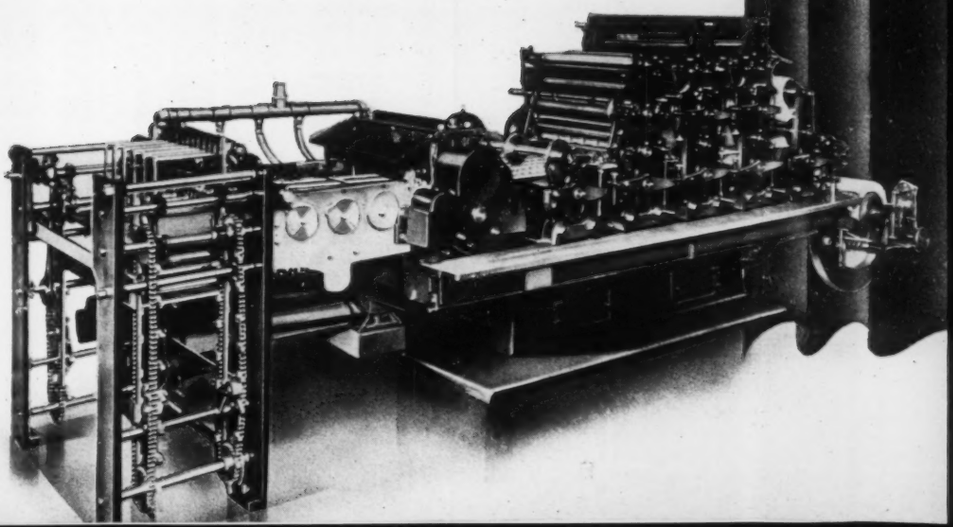
ation of Recent Machinery
andpoint of Design.



Trim in appearance with a sliding cover to hide dials and speaker, the Accousticon silent radio, left, incorporates the new tonal fork which permits deaf persons or only one person to hear it. A small bone conductor receiver conducts sound by vibration instead of air waves and is simply plugged into the special set.



Capable of printing, cutting and delivering in counted stacks 100,000 can labels an hour, the improved Chambon rotary press, right, promises to revolutionize package printing. The press is built for multicolor operation and delivers labels of any size or form.



New Machines Indicate Design Trends

While designers have been giving a good deal of attention lately to the elimination of noise and vibration in machines by the use of rubber mountings, it is only recently that an exact standard of noise measurement has been established. In the past it was principally a matter of guesswork by engineers whether a machine was above or below average as a producer of irritating discord.

With a standard of measurement, however, the engineer will be able to apply a noise meter to his machine and tell instantly if noise and vibration dampening appliances are necessary. Thus the trend to insulate moving units from stationary supports by rubber, spring or other types of mountings will undoubtedly grow. There will be no excuse for the engineer who might feign ignorance as to the amount of noise made by a machine.

Machines recently developed in addition to those on the preceding two pages include the following:

Air Conditioning

Air conditioning unit, Utica Radiator Co., New York.
Electrostatic precipitator, Pangborn Corp., Hagerstown, Md.

Construction

Shovel scoop truck, Yale & Towne Mfg. Co., Philadelphia.
Two new blade graders, Caterpillar Tractor Co., Peoria, Ill.
Concrete core cutting machine, Frank L. Howard Engineering Co., Los Angeles.

Conveying

Vegetable washer, Mathews Conveyor Co., Elwood City, Pa.

Dairy

Homogenizer, Marco-Sachs Co., Philadelphia.

Domestic

Electrical putty remover, Lawrence Tool Corp., Lawrence, Mass.
Refrigerators, Frigidaire Div. of General Motors Sales Corp., Dayton, O.
Electric fans, Wagner Electric Corp., St. Louis.
Table radio, RCA Mfg. Co. Inc., Camden, N. J.
Electric washing machine, Kelvinator Corp., Detroit.

Excavating

Excavator, Keystone Driller Co., Beaver Falls, Pa.

Industrial

Electric heater for melting, Sta-Warm Electric Co., Ravenna, O.
Four-in-one watch, Pierce Watch Co., New York.
Spray gun, Saylor-Beall Mfg. Co., Detroit.
Gyratory sifter, Allis-Chalmers Mfg. Co., Milwaukee.

Jewelry

Tilting furnace, Ajax Electrothermic Corp., Div. Ajax Metal Co., Trenton, N. J.

Metalworking

Electric drill, Stanley Electric Tool Division, New Britain, Conn.
Threading machine, Landis Machine Co., Waynesboro, Pa.
Crankshaft trimming press, Chambersburg Engineering Co., Chambersburg, Pa.
Vertical spindle milling machine, Brown & Sharpe Mfg. Co., Providence, R. I.
Hydraulic metal forming press, Farrel-Birmingham Co., Ansonia, Conn.
Wire stripper, Ideal Commutator Dresser Co., Sycamore, Ill.

Office

Payroll calculator, Thomas & Skinner Steel Products Co., Indianapolis.
Streamlined duplicator, Speed-O-Print Corp., Chicago.
Inter-communicating system, Webster Electric Co., Racine, Wis.
Time recording machine, International Business Machines Corp., New York.

Packaging

Automatic bag sealing machines, Consolidated Packaging Machinery Corp., Buffalo.
Automatic intermittent weigher-feeder, Syntron Co., Pittsburgh.

Photography

Automatic photo-taking machine, International Mutoscope Reel Co. Inc., New York.

Printing

Eight-magazine streamlined Intertype mixer, Intertype Corp., Brooklyn, N. Y.
Rotary gravure press, Chambon Corp., Garfield, N. J.

Textile

Broken needle detector, General Electric Co., Schenectady, N. Y.
Doubling, twisting, winding machine, Federal Machine Corp., New York.
7-cylinder combination sizer, Chas. B. Johnson, Paterson, N. J.
Multiple roll fulling mill, James Hunter Machine Co., North Adams, Mass.

Welding

Arc welder, Dongan Electric Mfg. Co., Detroit.

Woodworking

Hot plate press for plywood, Williams White & Co., Moline, Ill.

Competition Should Promote Recognition of Design Engineers

NOTHING gives greater satisfaction to the engineer with true creative ability than the accomplishment of a successful design. Constant contact with designers of all ages and types proves that it is not necessarily the monetary award or advancement that is remembered in connection with the laying out and development of a machine, but rather the degree of acceptance the machine achieves. As evidence of this, how often do we hear, from the old and even the young engineer, the story of his being responsible for the creation of a machine capable of performing work in a manner previously considered impractical? Occasionally such reminiscences are stretched out too far but nevertheless the claims are often justified.

Financial reward does not, however, always fall to the lot of the successful designer, and in consequence the $200,000 contest that has recently been announced by a welding foundation should prove of special interest to many. Successful applications of the welding process in design of machinery and in other fields provide a basis for recognition and award through the foundation.

Not only should this competition attract the attention of the individual designer. Manufacturing concerns as a whole stand to profit considerably by the new ideas and methods that unquestionably will be brought to light. Broadgage companies should be proud to have the members of their staffs enter the contest, particularly in the knowledge that it is only by the equitable interchange of thought and ideas that design can progress. As a stimulus to design in general, and to welded construction in particular, the contest now under way would be hard to beat!

• • •

Machine Drives

WITH increased speed in machines, coupled with the necessity for more accuracy in speed control, it is imperative that the engineer responsible for design give close attention to his choice of driving media. Trends in the application of drives, both here and abroad, are following the same general line brought about by the demand for faster production to cope with the current decrease in the working hours of operators.

It is to meet this situation and assist readers of MACHINE DESIGN in the selection of the most suitable drives for their particular requirements that a "Drives" section will be included in next month's issue. Practically all forms of drive will be covered in order to present as broad a picture as physically possible. Alert engineers will welcome the publication of this special section.

ASSETS *to a* BOOKCASE

Mathematics of Modern Engineering

By Robert E. Doherty and Ernest G. Keller; published by John Wiley & Sons Inc., New York; Vol. 1, 1936, 314 *pp.; available through* MACHINE DESIGN *for* $3.50 *plus* 15 *cents postage.*

As a textbook created for the advanced course in engineering at the General Electric Co., this one deals rather more with electrical than with other branches of engineering. It has been produced with the idea that too often other books have delved into mathematics without sufficient attention to their application. By the joint efforts of a mathematician who has worked in engineering and of an engineer who has worked in mathematics, the atmosphere of the engineering office and the classroom are combined in this book.

It is neither a text on mathematics nor one on engineering nor merely a handbook on engineering mathematics. It is rather, as the authors say: "First a guide in bridging the gap in engineering between physics and mathematics by the scientific method; and secondly, a presentation suitable for engineers, of those aspects of mathematics which the experience of a large manufacturing organization in dealing with electrical and mechanical problems has indicated to be of value to engineers. The engineer is interested primarily in the application of mathematics to the solution of problems, and hence if he sees how some function or theorem is used in a problem he will be better able to understand the use.

There are four chapters each of which, except the first, is introductory, the second is on basic engineering mathematics, the third on victor analysis and the fourth on Heaviside's operational calculus. An understanding of the calculus is presupposed.

□ □ □

Alloys of Iron and Carbon

By Samuel Epstein; published by McGraw-Hill Book Co., for Engineering Foundation, New York, 1936; 476 *pp. Available through* MACHINE DESIGN *for* $5.00 *plus* 15 *cents postage.*

This book is a technical treatment of the metallurgy of carbon steel and iron by the writer of a number of dissertations on ferrous metallurgy. Mr. Epstein's former connection with the Bureau of Standards and his present position as metallurgist at the Battelle Memorial Institute have well fitted him to be the author of this one of the Engineering Foundation's monographs. The fact that this book is stamped with the approval of the Iron Alloys committee of the Engineering Foundation is sufficient to establish its value.

New applications of the many alloys of iron in all the branches of engineering continually emphasize their ever-widening use to the members of the profession. A knowledge of their metallurgy is a prerequisite to their proper use and a great deal of general interest is at present being shown in the subject. This is evidenced by the numerous papers on alloys steels which have recently appeared in general engineering publications outside of the metallurgical field.

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Elementary Mechanism

By Philip K. Slaymaker; published by D. Van Nostrand Co. Inc., New York; available through MACHINE DESIGN *for* $2.25 *plus* 15 *cents postage.*

As the title indicates, this book was not written to provide an exhaustive treatise on the subject of mechanism. It is largely the outgrowth of the author's experience in the teaching and practice of machine design and was conceived to serve as a three-hour course which therefore necessarily limits the treatment of the various phases of the subject. Discussions are largely confined to fundamental principles and their application, with special attention to the subject of linkages.

□ □ □

Gear Design Simplified

By Franklin D. Jones; published by Industrial Press, New York; available through MACHINE DESIGN *for* $3.00 *plus* 15 *cents postage.*

Gear problems are presented in simple form in this new book which gives working rules and formulas for designers. Spur gears, internal gears, straight tooth and spiral bevel gears, single and double helical gears, worm gears, gear ratios and power transmitting capacity of gears are covered. Among the features are the 110 gear charts which with 201 drawings illustrate all types of gear problems.

MEN of MACHINES

J. ORMONDROYD

WELL known to the readers of MACHINE DESIGN as a contributor who is an authority on vibration, J. Ormondroyd now has taken up the teaching of dynamical subjects at the University of Michigan, with rank of full professor of engineering mechanics.

Mr. Ormondroyd, who was born in Philadelphia in 1897, graduated from University of Pennsylvania in 1920 with an A. B. degree. His college course was interrupted by the war, during which he served in the U. S. Air Service from 1917 to 1919. Following graduation he joined the Westinghouse Electric & Mfg. Co., taking the two year student course. After two years on electric heater engineering and six on motor engineering, he was appointed manager of the experimental division at South Philadelphia, resigning from that position on January 29, 1937.

• • •

HARRY M. WILLIAMS

ACTIVE for many years as an engineering and manufacturing executive, Harry M. Williams, manager of the standards division, Frigidaire Division, General Motors Sales Corp., is the new president of the American Society of Refrigerating Engineers.

Mr. Williams holds Bachelor of Science and Master of Science degrees from Otterbein College and a Bachelor degree in chemical engineering from Ohio State University. He began work as engineer of tests for National Cash Register Co., Dayton. Then, after a period with Remington Arms—Union Metallic Cartridge Co., Bridgeport, Conn., he became research chemical and metallurgical engineer with General Motors Research Corp. at Dayton, becoming associated with Frigidaire when the General Motors research laboratories were moved to Detroit.

• • •

CHARLES E. MACQUIGG

ANNOUNCEMENT has recently been made of the appointment of Charles E. MacQuigg to be Dean of the Ohio State University college of engineering, this appointment becoming effective on July 1, 1937.

Dean-Elect MacQuigg graduated from Ohio State in 1909 with a degree in mining engineering. Following graduation he spent a year with the Santa Fe railroad. He then became assistant engineer of tests for the Anaconda Copper Co. in Montana, devoting his attention to ore concentration, blast furnaces, smelting and refining. After this he was for five years head of the department of metallurgy at Pennsylvania State College.

During the World War Mr. MacQuigg served as captain in the U. S. Army Ordnance Department, being responsible for inspection and accept-

ance of all materials involved in the small arms program. For two years after the war he was in the research and development laboratories of the Electro-Metallurgical Co. at Niagara Falls. Since 1921 he has been with the Union Carbide & Carbon Co., Long Island City, N. Y., where he has been director of research since 1934.

Mr. MacQuigg has held important committee assignments with the American Institute of Mining and Metallurgical Engineers, which organization he represents on the National Research Council, and with the American Iron and Steel Institute, the American Society for Testing Materials and the Compressed Gas Manufacturers' Association. He also is a member of the American Society for Metals, the British Institute of Metals, and the Army Ordnance Association.

♦ ♦ ♦

WILLIAM D. WIGGINS has been made chief engineer of the Pennsylvania railroad. His headquarters is at Philadelphia.

♦ ♦ ♦

ARTHUR N. TALBOT, professor emeritus of engineering, University of Illinois, has been awarded the John Fritz medal for 1937 by the four national engineering societies. Professor Talbot, who is 79, was cited as "a molder of men, eminent consultant on engineering projects, leader of research and outstanding educator."

♦ ♦ ♦

BEN S. MOFFATT, formerly engineering director of the Caterpillar Tractor Co., Peoria, Ill., has been put in charge of the vocational training activities of the Associated Industries of Cleveland, representing the leading metalworking industries of that city.

♦ ♦ ♦

MAURICE P. SIEGER has been promoted from assistant chief engineer to chief engineer of United Engineering & Foundry Co., Pittsburgh. He succeeds HOWARD H. TALBOT who has been made senior engineer and general engineering consultant for the company.

♦ ♦ ♦

DR. JAMES S. THOMAS, who since 1933 has been president of Clarkson College of Technology, Potsdam, N. Y., has been appointed to head the staff of the Chrysler Institute of Engineering. From its original purpose of fitting graduate engineers of the Chrysler Corp. for master degrees, the scope of the institute has now been broadened to further the studies of undergraduates in Chrysler's employ.

♦ ♦ ♦

G. HIGBIE YOUNG has been appointed head of the department of machine design and engineering drawing of the Cooper Union Schools of Engineering, New York, with the rank of full professor.

♦ ♦ ♦

FRANK SCHUBERT, for the past three years assistant to the president of the Bearings Company of America, Lancaster, Pa., has joined the Houde Engineering Corp., Buffalo. As a consulting engineer, Mr. Schubert planned, equipped and initiated operation of the First State Anti-Friction Bearing Plant, Moscow, Russia, employing 15,000 people.

♦ ♦ ♦

ALFRED E. GIBSON has been elected president of the Wellman Engineering Co., Cleveland, succeeding GEORGE W. BURRELL who now is chairman of the board. (Note: A biographical sketch of Mr. Gibson appeared on page 55 of the November, 1936, issue of MACHINE DESIGN).

♦ ♦ ♦

W. H. HARRISON, assistant vice president, department of operation and engineering, American Telephone & Telegraph Co., New York, has been nominated for president of the American Institute of Electrical Engineers.

♦ ♦ ♦

FREDERICK G. SEFING, former assistant professor of metallurgy at Michigan State College, has been appointed to staff of the research laboratory of International Nickel Co., Bayonne, N. J., being assigned to cast iron research.

♦ ♦ ♦

FERDINAND JEHLE, formerly associated with the White Motor Co., Cleveland, and past chairman of the Cleveland section, Society of Automotive Engineers, is now director of the laboratory of the Hoffman Specialty Co., Stamford, Conn.

♦ ♦ ♦

DON J. LUTY, chief engineer of Gar Wood Industries Inc., Detroit, has been made assistant general manager of the company.

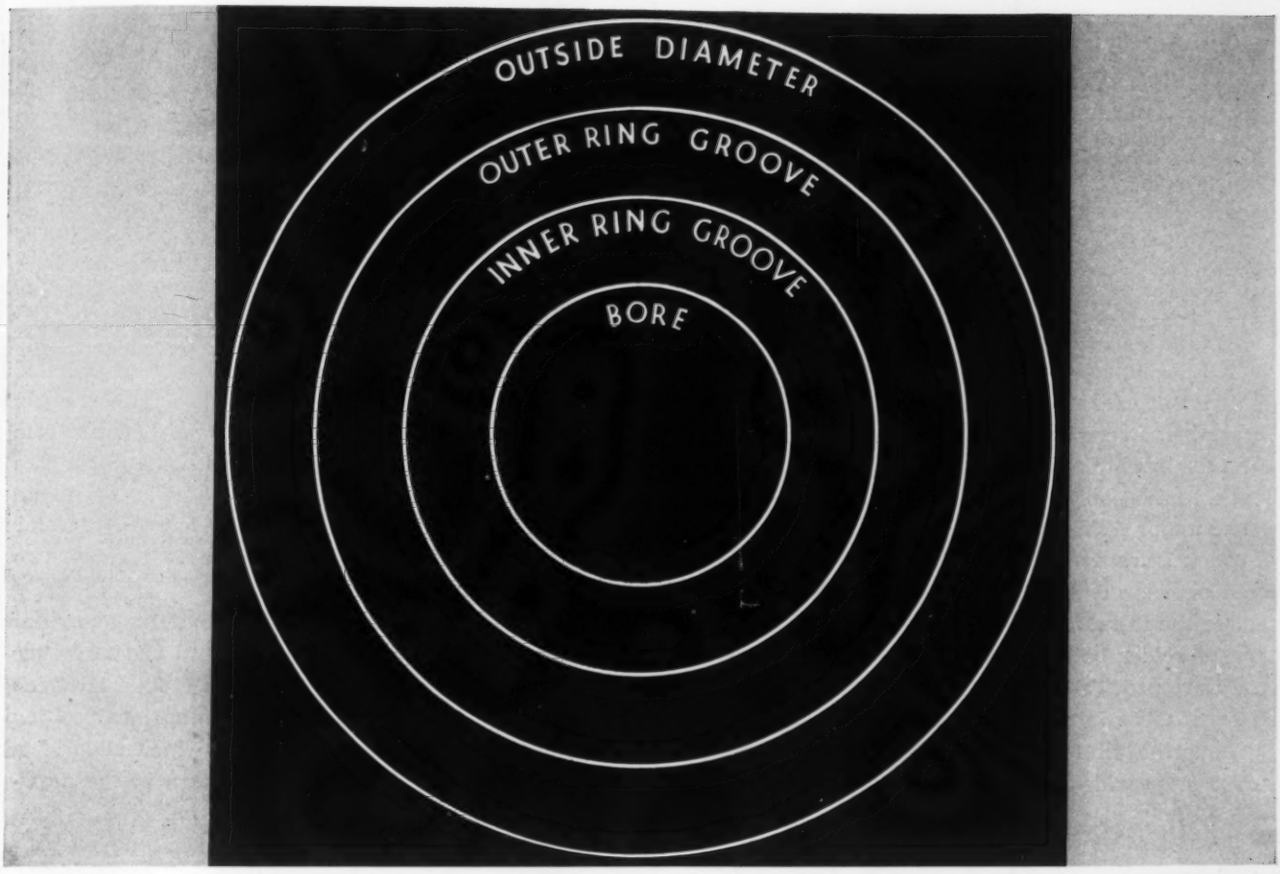
♦ ♦ ♦

DR. FRANK CONRAD, assistant chief engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, has been awarded the 1936 Lamme Medal by the American Institute of Electrical Engineers.

Obituaries

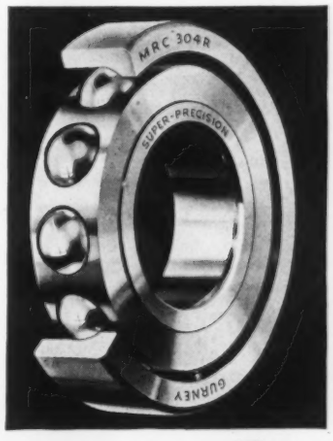
EMIL TRANAAS, assistant chief engineer, Koehring Co., Milwaukee, died of pneumonia on January 12. He had been affiliated with the company as mechanical engineer for seventeen years. Mr. Tranaas was born in Norway on July 9, 1896, attended school in Stavanger and Bergen, and graduated from the Technical College in Bergen. After graduation, he worked for about two years in Copenhagen, Denmark.

On December 5, 1919, he arrived in the United States and ten days after arrival was employed by the Koehring Co. as a detailer. In 1928, he became chief draftsman, and in 1933, assistant chief engineer. Mr. Tranaas was an authority on the development of mixers and pavers and was granted a number of important patents in that field. He was a member of the Engineers' Society of Milwaukee.



A SUPERLATIVE ACHIEVEMENT IN CONCENTRICITY CONTROL

● THE most important characteristic in a Super-Precision Ball Bearing is the maximum allowable eccentricity of the inner race. Marlin-Rockwell has developed a special method of producing a concentric race ... holding the eccentricity of the inner ring, on the smaller sizes, to .0001" or less. Relative accuracies apply to all other external as well as internal dimensions. Such a degree of accuracy in one circle is quite a feat and to produce four related circles of the same equivalent accuracy is far more difficult. But in every M-R-C Super-Precision Ball Bearing such accuracies are rigidly maintained.



While Super-Precision standards are not needed in most ball bearing applications, every engineer must recognize that accuracy and concentricity of the circle and parallelism of faces are basic in ball bearing design. All M-R-C Ball Bearings embody in some degree the improved control of uniformity which makes M-R-C Super-Precision Ball Bearings possible. Every M-R-C Ball Bearing is a better bearing than it would be if M-R-C Super-Precision bearings did not exist.

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M-R-C *Ball Bearings*

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M-R-C SUPER-PRECISION BALL BEARINGS ESTABLISH NEW STANDARDS OF ACCURACY

Noteworthy Patents

FOR the purpose of applying glass panels to the ends of cans, a machine has been developed by Alred L. Kronquest of Syracuse. The patent covering this invention is No. 2,057,037. It has been assigned to the Continental Can Co., New York.

The major features of the machine are shown in *Fig.* 1, which is a view looking down on its indexing turret from above. The object of the mechanism is to assemble the metallic can ends with glass panels preparatory to solder bonding the two. The glass panels already are provided with metal rims which are deposited so as to be integral with the glass.

The principal feature is an intermittently rotating turret *A* provided with a series of holders *B* evenly

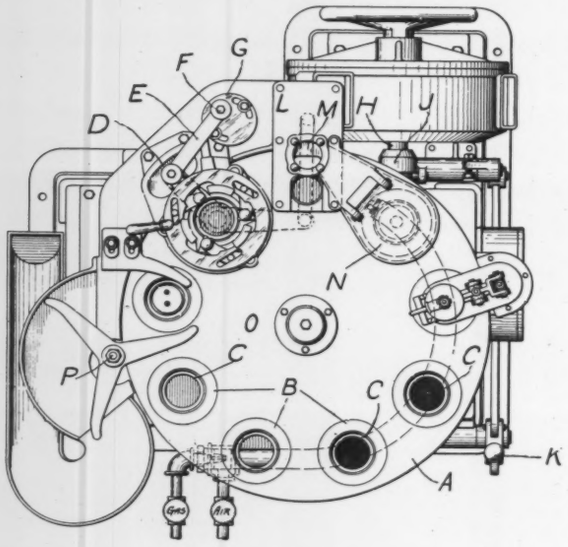

Fig. 1—Magazines feed can ends and glass panel onto an indexing turret for assembly

spaced around its outer edge. These are shaped to support a can end around its periphery, leaving its central opening *C* exposed from below.

As the turret indexes, each holder is in turn brought in line with station *D* at which is located the magazine from which are fed the can ends. These are released one at a time into the holders *B* by means of an oscillating ring operated by link *E* attached to crank *F* on disk, *G*.

The moving parts of the machine are actuated through main drive shaft *H*, being stopped and started by means of a clutch of which *J* is the shifting spool and *K* the operating lever. A cross shaft driven from the mainshaft by worm and wormwheel, carries a cam drum by which turret *A* is indexed, also an edge cam which works an ejector mentioned later. Drive for crank disk *G* is taken off this cross shaft, through two sets of bevel gears.

At *L* is located a second magazine containing the heat resisting glass panels. They are pushed one at a time from the bottom of the stack by a feed slide *M* which causes them to drop through an opening into position in a can end below. The linkage by which slide *M* is operated from crank disk *G* can be seen in the drawing. When can end is being fed into a holder *B*, a glass panel is also being fed into the can end in the next position.

Next the assembled parts are indexed over a series of gas-heated positions, from the first of which a hood *N* carries residual heat to preheat the glass panels in the magazine at *L*. Following the first heating, the assembly comes to a flux-applying device, and then at one of the other heating positions soft solder is applied by the operator, thus effecting the bond. The two positions beyond the burners are cooling stations, and ejection of the finished work occurs at *O*, through the action of star wheel *P*. This sweeps the assemblies from the turret into a trough, after they have been lifted out of their holders by an ejector mechanism which gives an upward thrust from below. It will be noted that aside from the application of the solder, the cycle is automatic.

PATENT No. 2,057,761, granted to Arthur Bolton of Coventry, England, covers improvements in the type of friction clutches in which pressure between the friction surfaces increases automatically with the transmitted torque in either direction.

Design and application of the improved clutch is depicted in *Fig.* 2, which is a longitudinal section showing adjacent ends of the driving and driven shafts. In this drawing *A* and *B* are the driving members, *C* and *D* are the driven members or cones, and *E* and *F* are the driven rings or complementary members of the clutch.

Adjacent faces of the driving members are recessed

Specify **BOSTON STOCK GEARS FOR RIGHT ANGLE DRIVES**

When you drive at right angles, select your driving medium from our complete stocks of bevel and miter gears. Exactly forty-three ratios of bevel gears and exactly fifty-six sizes of miters are described in detail on pages fifty-one to sixty-two in our new catalog number fifty-one. Each one of these gears is a stock item and can be supplied from any of our forty-five distribution centers throughout the country. Simplify your right angle drive problems and avoid costly delays by specifying Boston Stock Bevels and Miters.

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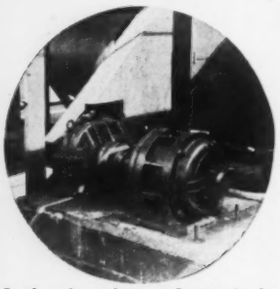
SEND FOR YOUR FREE COPY OF GENERAL CATALOG 51

BOSTON GEARS

the Herringbone Speed Reducer

JONES speed reducers are built in worm, spur and herringbone types and the Jones organization has been working closely with the engineers of almost every industry on a wide variety of problems involving the application of these three types of reducers.

This experience has shown that the herringbone speed reducer is sometimes overlooked and particularly so in the lower range of ratings. Even for drives as small as 1 H.P., herringbone reducers may have points of superiority as compared with either worm or spur gear reducers—so we say don't overlook the herringbone reducer when making a study of your drive problems.



In the view above a Jones single reduction herringbone reducer is driving a distribution conveyor in a large coal handling plant and the application shown below is a double reduction reducer driving a screw conveyor in a cement plant. Jones herringbone gear speed reducers are built in ratings from 1 to 400 H.P. and in single, double and triple reductions covering ratios from 1¼ to 1 up to 300 to 1.

W. A. JONES FOUNDRY & MACHINE CO.

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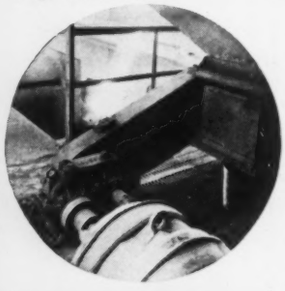
Here is interesting information about herringbone speed reducers and other Jones transmission products. Write for your copy of "In the Service of Industry."



Since 1890

Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS

CUT AND MOLDED TOOTH GEARS — V-BELT SHEAVES

ANTI-FRICTION PILLOW BLOCKS — PULLEYS

FRICTION CLUTCHES AND TRANSMISSION APPLIANCES

at *G* to receive compression springs *H* which tend to force the two parts away from each other along splined driving shaft *J*. The outer faces of driving members *A* and *B* are each formed with an annular series of radially arranged V-shaped projections adapted to co-act with mating surfaces on the inside faces of driven members *C* and *D*. Driven members *C* and *D* are free to rotate on the driving shaft. They are positioned at the outer sides of the driving members. The driven members are connected by means of dowel pins *K* projecting from each face of a ring *L*. This is loosely mounted on the driving members between movable clutch members *C* and *D* to insure that said members shall move in unison.

Driven rings of the clutch are bolted to flange *M* which is free to slide upon driven shaft *N* being rotatable therewith. The rings and their connecting bolts *O* are supported by plate *P* which is rotatably mounted on dowel ring *L*. Axial movement of cones *C* and *D* in the direction of disengagement from driven rings *E* and *F* is limited by the clearance between driving members *A* and *B*.

The clutch is operated by collar *R* which slides on driving shaft *J*. Adjacent faces of this collar and of

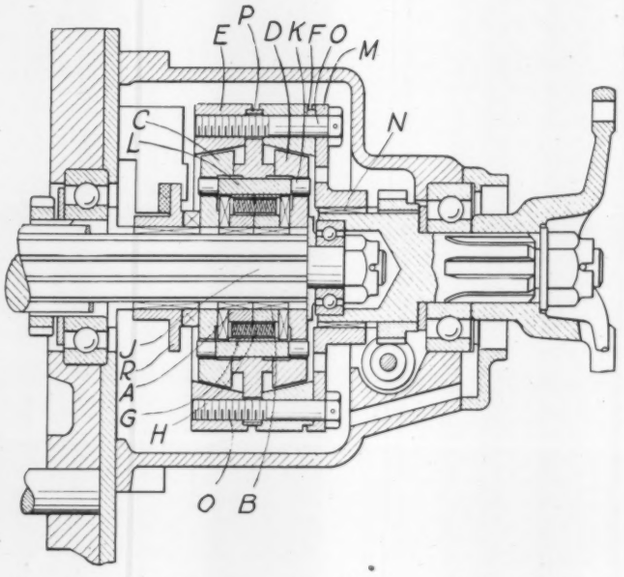
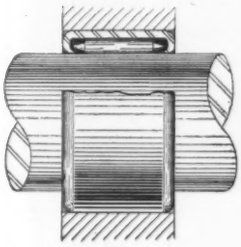


Fig. 2—Pressure between the friction surfaces increases automatically in proportion to torque

movable clutch member *C* are provided with V-shaped radial teeth of smaller pitch and sharper angle than those on the driving and movable clutch members.

During initial engaging movement of the clutch operating collar, the movable clutch members are first brought into frictional engagement with their mating members, pressure being predetermined by influence of the springs. Further engagement is controlled by action

This new bearing is



Easy To Install

SINGLE COMPACT UNIT REQUIRES SMALL SPACE—SAVES TIME IN ASSEMBLY. THE IDEAL BEARING SHOULD HAVE THESE FEATURES

DUE to its unit construction and the small space which it requires, the new Torrington Needle Bearing is surprisingly easy to install.

The use of loose rollers around a shaft is not new, but formerly assembly was complicated by the number of individual rollers which were difficult to handle and were apt to become lost on dis-assembly. The Torrington Needle Bearing overcomes these disadvantages. It is a complete self-contained unit —a full complement of rollers in a single retaining shell. This unit construction greatly simplifies handling, makes lubrication easier, insures a clean job, speeds assembly operations and facilitates dis-assembly.

Because of the relatively small diameter of the rollers and the thin tough shell of the retaining race, very small space is required for installation—often less than for a bronze bushing. Moreover, because of the unusually high radial load capacity of the Needle Bearing, due to the many lines of contact, it is possible to carry greater loads with smaller diameter shafts. The size and design also simplify construction of surrounding members. Smaller housings may be used with consequent reduction in size, weight and cost.

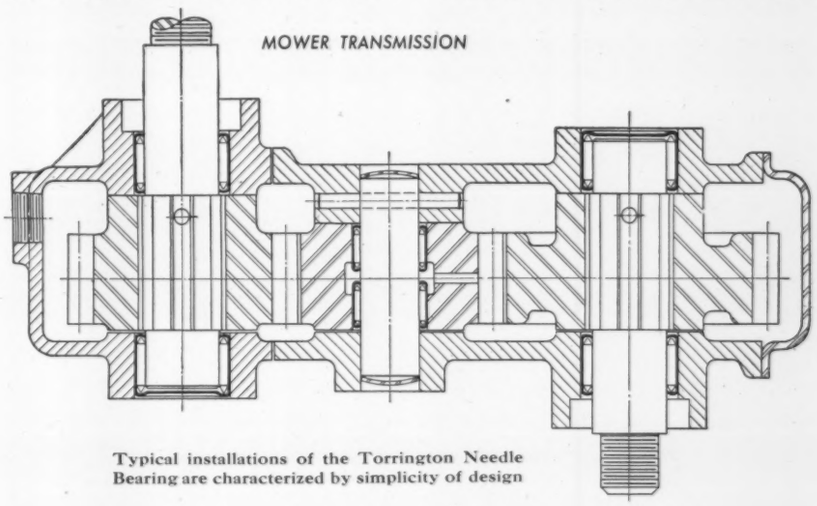
An accurately made shaft is required, of course, as it serves as the inner race for the bearing and must be hardened and ground to correct size. For applications where an unhardened shaft is desired, inner races are available.

A Single Operation

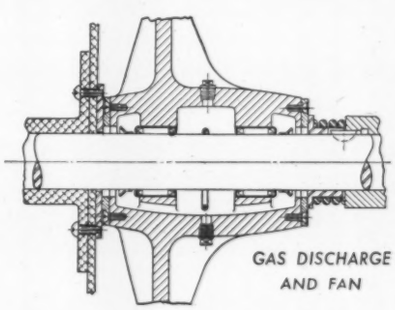
The housing bore is simply machined to proper diameter to take the bearing and provide assembly tolerances between limits of .0005″ and .0029″ as desired. Customary good shop practice will answer these simple requirements. The Torrington Needle Bearing is simply pressed into the housing bore. A 15° angle concave punch with pilot of shaft size is recommended for assembly. An arbor press is highly suitable.

Like every other Torrington product, the new Torrington Needle Bearing is built to give continuous economical service.

The experience of Torrington's engineering staff is at the disposal of manufacturers interested in the use of the Needle Bearing in their products. A Torrington representative will gladly discuss the advantages and cooperate in developing designs and laying out applications.



Typical installations of the Torrington Needle Bearing are characterized by simplicity of design



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Branch Offices in all Principal Cities

FEATURES OF THE TORRINGTON NEEDLE BEARING

Small Size — **Ease of Installation**
Efficient Lubrication — **Low Cost**
High Radial Load Capacity

Further information and data on the new Torrington Needle Bearing, the types and sizes available for immediate shipment from stock, etc., available on request. Write for *Catalog No. 9.*

TORRINGTON
NEEDLE BEARING

PRECISION

BEARINGS

in 108 distinct series

To the machinery world, NORMA-HOFFMANN offers the most comprehensive line of anti-friction bearings in America—108 distinct series—ball, roller, needle and thrust types—1/8" to 21" bore, metric and inch sizes.

Many of these types have been pioneered by NORMA-HOFFMANN engineers to meet specific requirements growing out of advancing methods in machine design, manufacture and operation.

Today, with this wide choice of PRECISION BEARINGS available, engineers are no longer compelled to adapt their designs to the comparatively few standard bearing types of past years. There's a PRECISION BEARING for every load, speed and duty.

Write for the Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORP'N.

STAMFORD, CONN., U. S. A.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

of the mating teeth on operating collar *R* and driven member *C*. This prevents cones *C* and *D* from jumping into their self-energizing positions with respect to driving members *A* and *B*.

HANS WOLLNER of Detroit has been granted a patent on a universal joint designed for economical manufacture and easy demountability. This patent, which is number 2,058,544, has been assigned to Universal Products Co.

Two views of the joint are shown in *Fig.* 3, the upper being a plan view and the lower a side elevation. The major elements of the assembly are two yokes, *A* and *B*, and a 4-armed coupling member *C*.

Each yoke includes a pair of spaced bearing portions which can to some degree be forced toward each other by means of a bolt. The inner surfaces of both legs are arced and are adapted to receive a split circular bushing. This bushing has a peripheral groove into which the before-mentioned bolt enters, thus holding the intermediate member in assembly with the legs of the yokes. Each trunnion of the coupling member *C* carries a cup to house a roller bearing. These cups are designed to fit the fork bushings.

In assembling the joint, the bearing cups are fitted over the ends of the trunnions of the demountable yoke. Then coupling and bearing cups are moved into the space between the yoke legs, the spacing between the forward ends of each pair of legs being somewhat larger than the diameter of the bearing cups. With the parts in this relation, a bushing may be fitted over each bearing cup between the respective legs.

Upon insertion and tightening of the bolt associated with each pair of legs, the legs are drawn together, restricting the bushings and forming a tight joint between legs and bushings and between bushings and bearings.

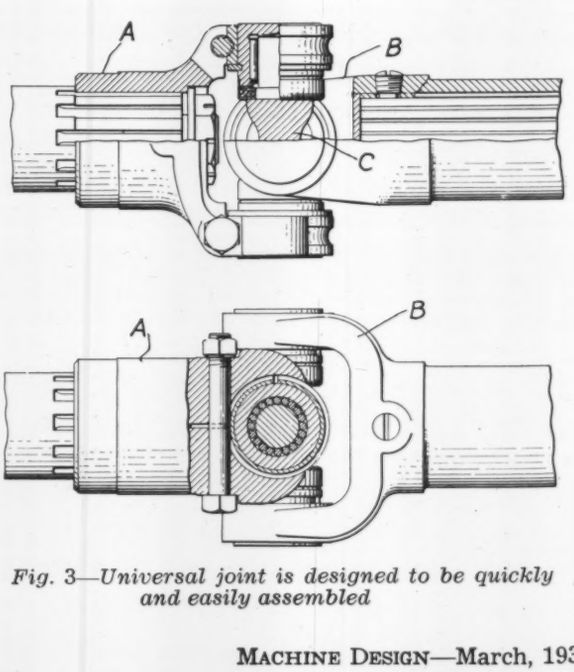
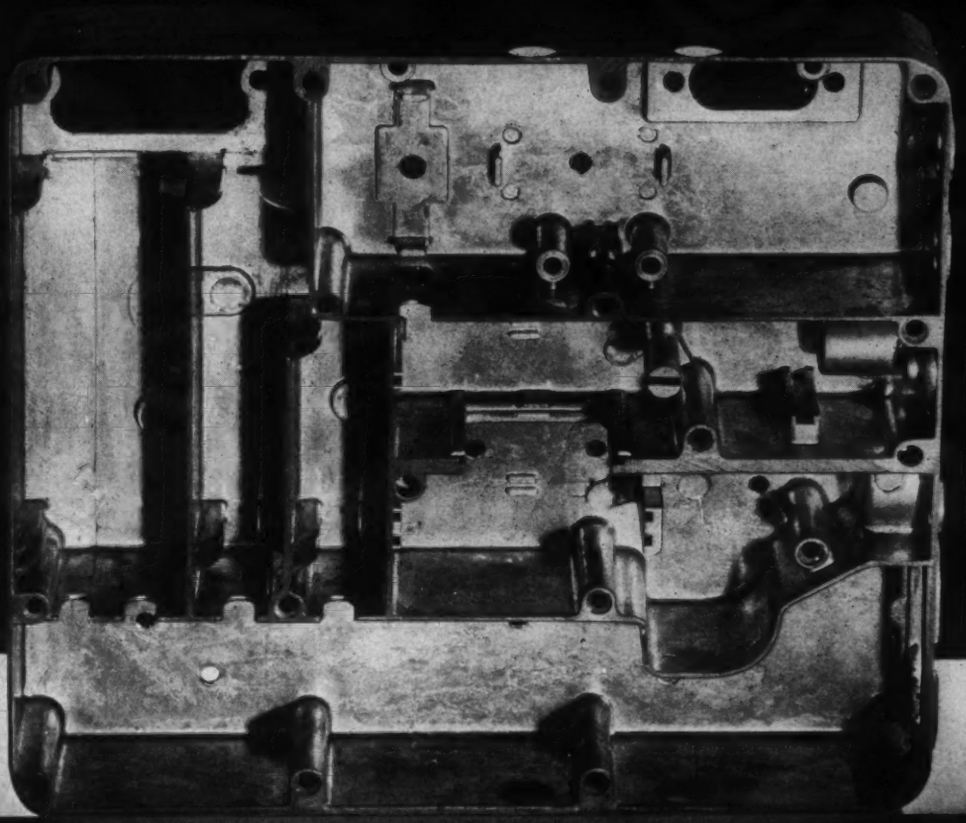
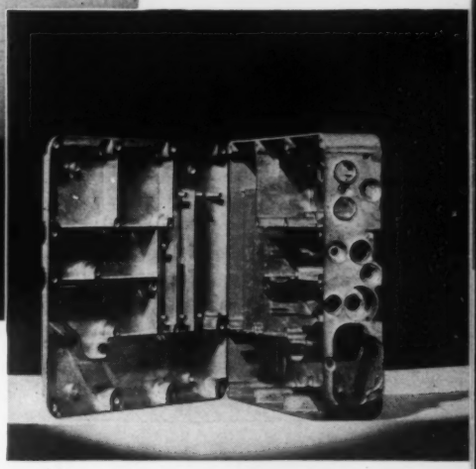


Fig. 3—*Universal joint is designed to be quickly and easily assembled*

ZINC ALLOY DIE CASTINGS



COMPLEXITY



—IN A SINGLE SHOT

We would like to be able to place this die casting in the hands of every design engineer—for his personal inspection. Failing this, we present it to you photographically, for we are sure that its complexity will impress you—die cast in one shot with ZINC Alloy.

The part is used, with the ZINC Alloy Die Cast covers shown in the small illustration, in a popular automobile radio. We ask you to observe these features:

1. **DIMENSIONAL ACCURACY**—to insure a close fitting, neat appearing, ZINC Alloy Die Cast housing.
2. **THIN WALLS**—1¼" in height with practically no taper.
3. **ECONOMY OF METAL**—through the ingenious use of lugs for assembly screws.
4. **CORED HOLES**—in several directions, some of which are used as bearings.
5. **BUTTRESS-LIKE GUIDES**—which simplify the placement of electrical elements in their proper position.
6. **THE CAREFUL USE OF STRENGTHENING FILLETS.**

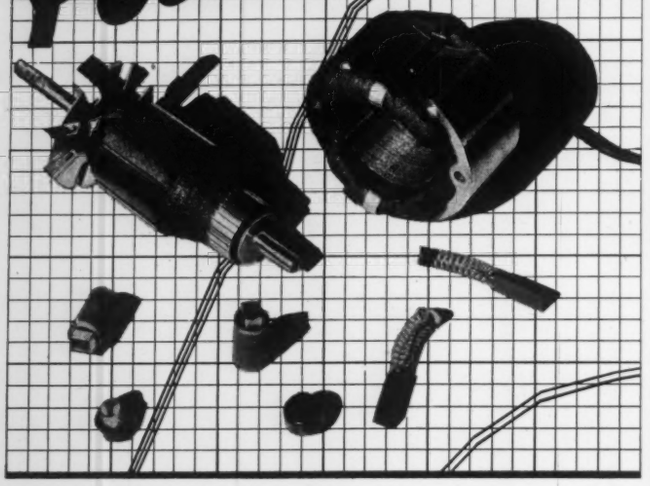
Any commercial die caster will be glad to discuss ZINC Alloy Die Castings and their possible application in *your* products—or write to this Company for additional information.

THE NEW JERSEY ZINC CO.
160 Front Street New York

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% UNIFORM QUALITY) ZINC

5-Time Inspection GIVES DUMORE MOTORS MORE Power Hours



Dumore parts and motors get a 5-time inspection in manufacture — and in addition, an *ENGINEERING* inspection—all assuring the utmost in performance.

- Armatures are dynamically balanced at high speed and then tested and retested to assure vibrationless running.
- Armature windings are expanded at high speed, then sealed, and finally tested to make sure there is no "breathing."
- Commutators are ground concentric with the bearings and given running tests to assure maximum brush life.
- Armature leads are swaged by special Dumore process and tested for 100% electrical contact.
- Assembled motors are "run-in" to seat brushes and are then given final electrical tests and inspection.

Dumore makes a full line of Universal Motors — 1/600 to 3/4 h.p. — A. C.-D. C. — 0 to 60 cycles — and you can get parts "tailor made" to fit specific products. Let Dumore Engineers help you. Engineering Service Application blank sent with new catalog. Write today.

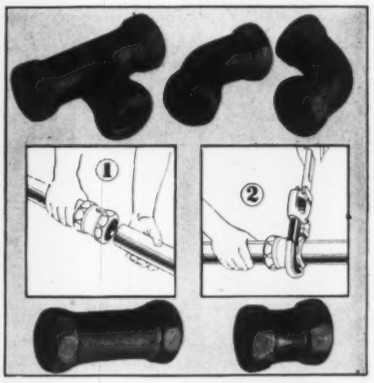
THE DUMORE COMPANY
Dept. 127-C RACINE, WIS.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

NEW Materials and Parts

Fittings Eliminate Pipe Threads

ELIMINATION of pipe threading has been accomplished with a new line of compression fittings introduced by the S. R. Dresser Mfg. Co., 550 Fisher avenue, Bradford, Pa., which make a permanently tight joint. After inserting the plain-end pipe into the fitting, it is only necessary to tighten two threaded octagonal follower nuts which compress "armored" gaskets at each end of the fitting, forming a positive seal around the pipe. The resulting joint is said to absorb normal vibration, expansion and contraction movement, and to permit deflections of the pipe in the joint. If the pipe is already threaded, it can be joined in the same way. The fittings are recommended for simplifying joint-making in both inside and outside piping for oil, gas, water, air, or other industrial lines.



Pipe threading is eliminated with compression type fittings

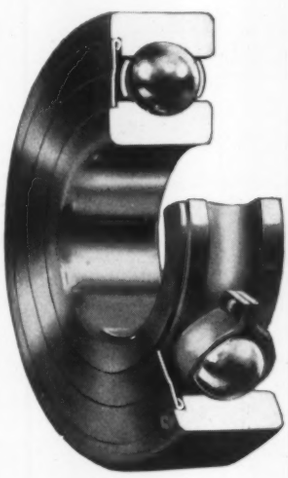
Two Relays Are Offered

COMPACTNESS and flexibility have been built into two new relays developed by the Guardian Electric Mfg. Co., 1622-P West Walnut street, Chicago. Such features as full floating, permanently locked armature, ability to remain in constant operation without heating or sticking and adjustable air gap with permanent setting make the new series 110 for alternating current and the series 115 for direct current particularly suited for severe applications.

Hum and chatter, a common occurrence in alternating current relays, has been eliminated by use of a large shading ring attached firmly to the core of the

TAKES MORE LOAD
THAN POWERFUL ELECTRIC CRANE

THE BCA-equipped crane of a prominent manufacturer must stand up under heavy loads—and stand up without accident. The BCA Bearings specified care for a load stress beyond the limit of the crane. They insure safety with overload. Radial, thrust or angular contact — special built or regular—there's a BCA Bearing to stand the stress wherever loads are heavy. BEARINGS COMPANY OF AMERICA, 517 HARRISBURG AVENUE, LANCASTER, PENNA.

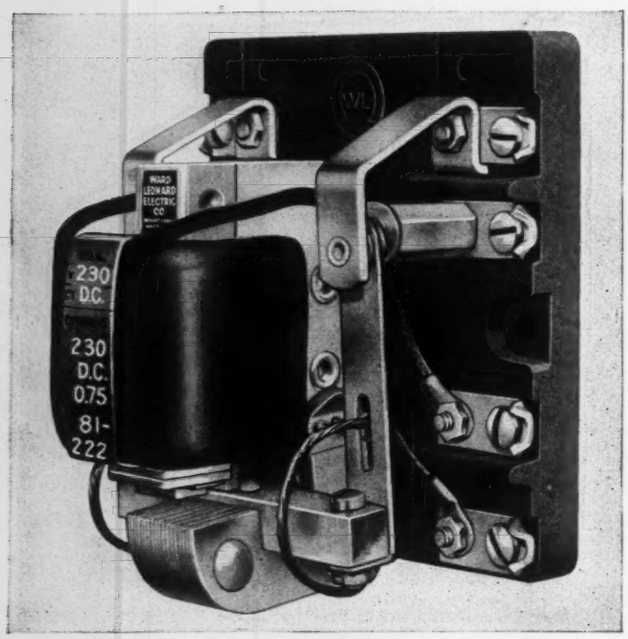


300 S SERIES BCA SINGLE ROW RADIAL BEARINGS WITH SHIELDS

This type BCA Bearing withstands the stress of heavy loads swung by electric hoists in foundries, warehouses and on loading platforms. A leading hoist maker whose policy has to be "safety first" — rates these bearings first in safety by installing them in his own equipment.

BCA

RADIAL · THRUST · ANGULAR CONTACT
BALL BEARINGS

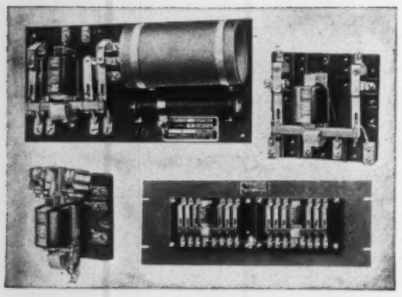


THIS IS THE

basic relay

for Automatic and Remote Control

There are many different arrangements built around this Ward Leonard Intermediate Duty Relay. Various pole combinations, contact arrangements and auxiliary equipment make it possible to use this basic design for practically every purpose within its current limitations. Thus an efficient relay for special requirements can be produced without undue delay and expense. It is described in *Bulletin No. 81.*



Here are a few of the possible relays built up from type No. 81

OTHER BULLETINS AVAILABLE

Bulletin No. 106
Midget Magnetic Relay

Bulletin No. 131
Heavy Duty Relay

Bulletin No. 251
Sensitive Relay

Bulletin No. 362
Time Delay Relay

WARD LEONARD

RELAYS · RESISTORS · RHEOSTATS

WARD LEONARD ELECTRIC CO.
46 South Street, Mount Vernon, N. Y.

Please send me Relay Bulletins Nos.....

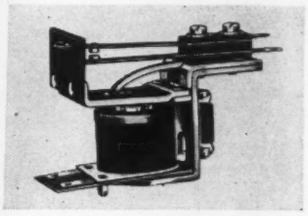
Name.....

Firm.....

Address.....

City..... *State*.....

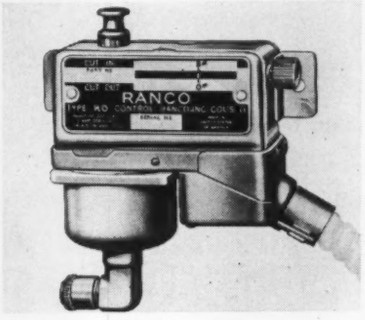
coil. Fine silver contact points riveted to phosphor bronze springs and adjusted to give the proper amount of rub when actuated by the armature are provided on both of the relays. Either can be supplied mounted on a Bakelite base with contact leads wired to specifications. All parts are cadmium plated.



Silver contact points provide long life in both alternating and direct current relays

Compactness Features Thermostat

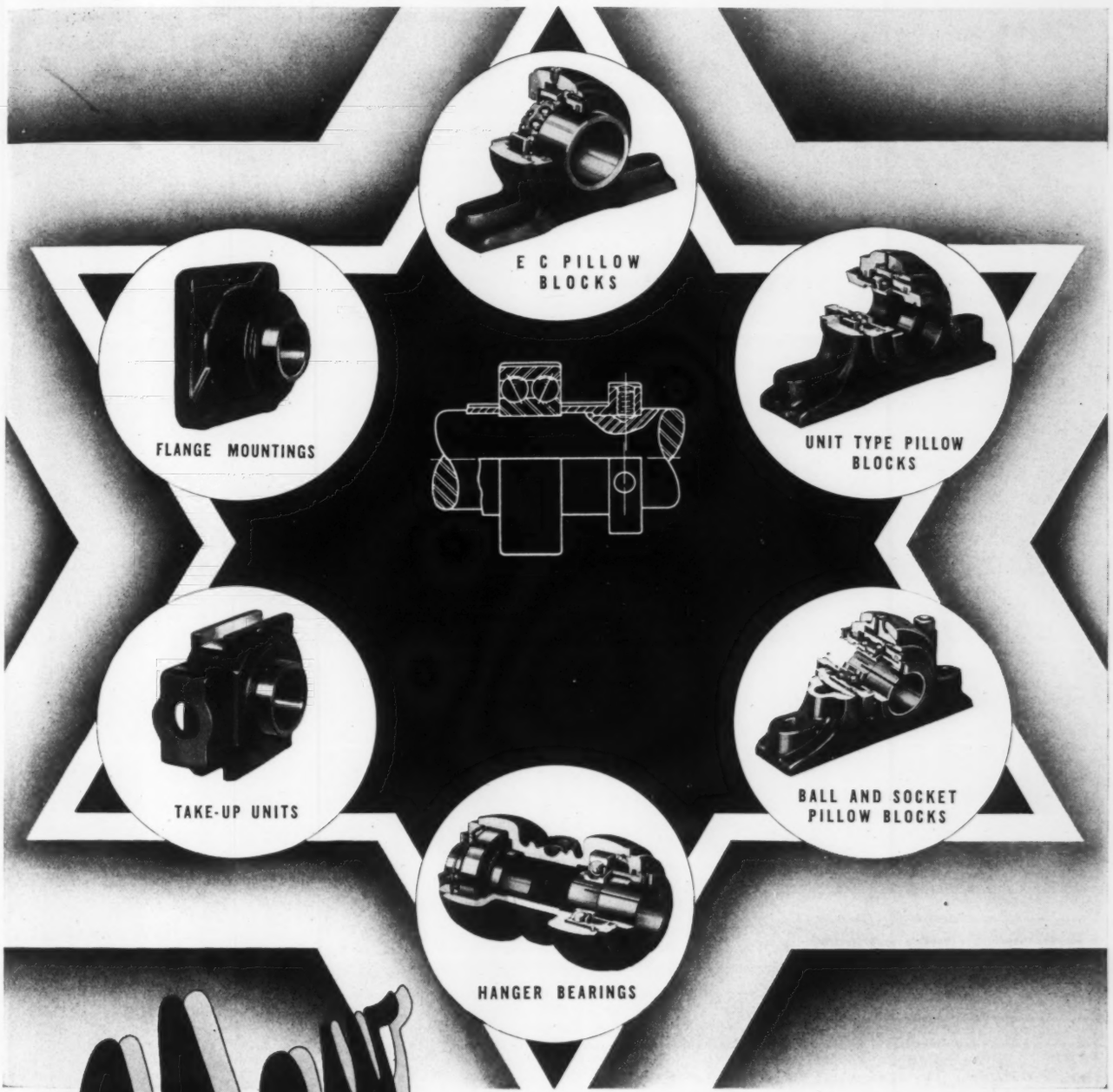
DESIGNED for general commercial use in pressure and temperature control a new stainless steel, corrosion-proof thermostat has been brought out by Ranco, Inc., Columbus, O. It is recommended for air conditioning applications, various types of cooling units and unit heaters and can be built into machines or installed subsequently. The thermostat has a wide range and the range calibration indicator is visible through a window covered with transparent material which excludes dust. The unit is compact requiring only small mounting space yet has a high electrical rating of ¾ horsepower.



Calibration indicator on thermostat is visible through small window

Motor Is Resiliently Mounted

ANNULAR resilient mountings feature a new repulsion-start-induction motor recently placed on the market by the Wagner Electric Corp., 6400 Plymouth avenue, St. Louis. Large rings of rubber which support the shaft are vulcanized to inner and outer steel rings, reducing vibration and lessening noise. The base is shaped in the form of a cradle for supporting the motor and is made of rolled sheet steel making it



New

. . . AND IN TUNE WITH PRODUCT AND PLANT MODERNIZATION NEEDS

The new C J B Transmission Units not only represent the most complete line offered by any manufacturer, but in addition one which embodies the only noteworthy improvements within the last two decades!

Imagine, for example, the advantages of being able to select from three distinct types of Pillow Blocks any one of nine different capacities for a given shaft size. This unusually wide range of capacities and types (see above) together with many other new and revolutionary features makes the C J B line the logical one to consider in your plant or product modernization programs.

Complete stock now carried by our 28 branches. Write for Catalog and address of nearest branch.

AHLBERG BEARING COMPANY
317 East 29th Street — Chicago, Illinois

C J B PILLOW BLOCKS

WRITE FOR YOUR COPY

Here is one of the most complete (and helpful) catalogs (ever) published on power transmission equipment. Every engineer and maintenance executive should have one on file. Write for your copy today.

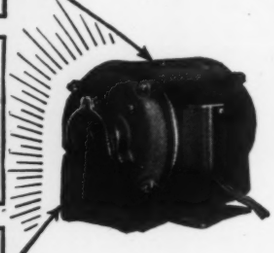
Important to MOTOR Users and Buyers

NEW applications for electric motors are continually being developed. In every industry where motion is a necessary part of the machine or appliance, electric motors are being applied as the best solution for the motive power. The demand for *satisfactory motors* to drive new devices and machinery has greatly increased.

Motors to meet this demand are judged largely upon the basis of their efficiency, dependability, performance characteristics, quietness and appearance. Wagner motors are chosen by the leading motor buyers because they embody all the requisites of well-balanced design. Below is shown a Wagner motor equipped with the new type resilient annular-mounting. The boxes and arrows point out a few of its many features.

FRAME AND ENDPLATES are strong and rigid, and accurately machined — assuring permanent alignment of bearings and uniform air gap, two essentials for quiet operation.

STEEL - BACKED BABBITT - LINED BEARINGS are diamond-bored to secure bearing clearances small enough to avoid any possibility of excessive play and at the same time have ample clearance to afford a liberal oil film between shaft and bearing.



BASE consists of formed steel plate. There are no feet to break off in shipment or during mounting.

ROTOR is dynamically balanced to eliminate vibration and noise arising therefrom. The number and the dimensions of rotor slots are carefully chosen to minimize magnetic noise.

Wagner builds a complete line of motors. They are available in any standard horsepower, speed, and voltage rating; in many mechanical variations, such as, flange-mounting, resilient-mounting, double-shaft extension, etc.

When developing your next machine, call in a Wagner sales-engineer for advice regarding the proper motor for the job. Just phone or write the nearest of our twenty-five branches for prompt consultation service.

Wagner Electric

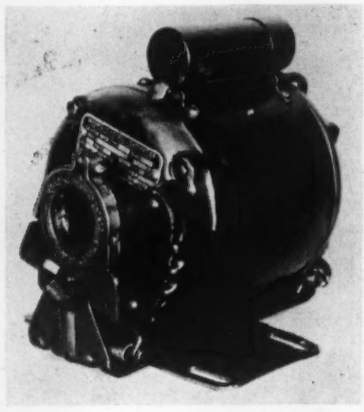
6400 Plymouth Avenue • Saint Louis, U. S. A.

MOTORS · TRANSFORMERS · FANS · BRAKES

MS337-1J

strong, rigid and unbreakable.

To meet the requirements of refrigerator manufacturers and other makers of belt-driven appliances, the new type of motor is available with belt tightener bases. They are so designed that the belt tension varies

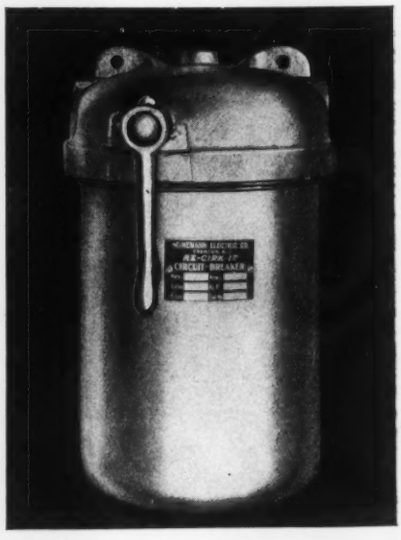


Belt tightener bases are available for new rubber-mounted motor

directly with the load and thus prevents belt slippage. The motors are being produced in ratings from ⅛ to one horsepower.

Housing Protects Circuit Breaker

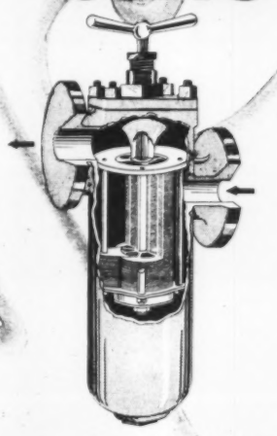
A SPECIAL housing has been provided by the Heinemann Electric Co., Trenton, N. J., for its Re-Cirk-It circuit breakers to assure protection in hazardous locations where flammable gases and explosive dusts prevail. A two-part metal casting houses the circuit breaker in place of the usual pressed steel cabinet. The



Improved circuit breaker housing is provided with handle for easy operation

circuit breaker is mounted on the upper section and is actuated by an approved bushed handle which closes and opens the circuit independently of the tripping action of the enclosed breaker. Those made for the

IN YOUR DESIGN···PROVIDE CUNO *Continuous* FILTRATION



Schematic section of a typical CUNO FILTER, showing direction of flow. Your substance enters the filter case and passes under gravity, pressure or suction head through the closely spaced filtering discs which catch the suspended solids. Then, rotation of the entire element, either manual or mechanical, against the stationary cleaning blades, combs out the filter and drops the unwanted substance to the ample sump below. The filtered and cleaned substance rises through the interior of the cartridges and passes out through the outlet indicated.

When you design for the uninterrupted flow of any liquid for hydraulic, lubricating, process or fuel functions—be sure to include a filter with the certain quality—*continuously cleanable*—that CUNO Auto-Klean FILTERS guarantee. Their operation may be manual or fully automatic,—either way you provide a positive, clean flow of liquid that kills the wasteful disadvantage of "stop-and-go" filtration methods, premature wear and even shutdown.

The specialized application of CUNO *Continuously Cleanable* FILTERS to modern machine tools and industrial processes runs the gamut of services and products where filtering for faultless lubrication, straining for reclamation, product improvement and freedom from screen scrubbing are the vital needs. From the small units which keep lubricants steadily free of sludge and abrasive grit, to the big, multiple cartridge, power driven strainers handling thousands of gallons of process liquids per minute, there's a CUNO FILTER in a size and type to become an integral part of your machine that will save dollars in operating costs. Ask for details.

CUNO

ENGINEERED FILTRATION

CUNO ENGINEERING CORPORATION - MERIDEN, CONN.

CUNO ENGINEERING CORP.
Dept. 30, 90 So. Vine St.
Meriden, Conn.

Gentlemen: Please send me bulletin of CUNO FILTERS for service on.....

.....

and information on your confidential engineering service.

Name.....

Company.....

Address.....

City.....State.....

The Cleveland Worm & Gear Company and Designers of Rubber Plant Machinery have Co-Operated for 20 Years

ONE of the outstanding achievements in Engineering Design in recent years has been the development of new machinery for manufacturing better rubber products in greatly-increasing volume.

For nearly 20 years, Representatives of The Cleveland Worm & Gear Company have blazed new trails in cooperation with Design and Plant Engineers in applying Worm Gear Speed Reducers to the most trying and difficult installations. "Clevelands" today are driving Calenders, Mills, Conveyors—and in addition more than 70 different kinds of rubber plant equipment.

The benefits of "Cleveland's" 25 years of successful experience in designing, manufacturing and applying Worm Gear Speed Reducers are at your disposal, regardless of the kind of machinery you build. A nearby District Representative will call at your convenience. The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

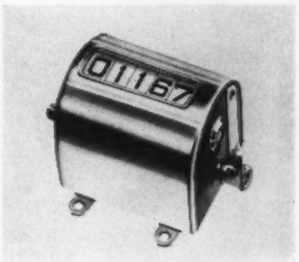
Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND *Worm Gear Drives*

special housing are available in any capacity from 50 milliamperes up to 35 amperes and in one, two and three poles. The fully magnetic and non-thermal circuit breakers provide precise overload protection and may be instantly reset after tripping if the abnormal condition no longer exists.

Action Is Positive in Counters

UNUSUALLY small but dependable, the Production Instrument Co., 1325 South Wabash avenue, Chicago, has introduced an improved mechanical counter known as SMC-1 especially adapted for production machinery, office machines, and many other built-in applications on small machines. The large legible figures have a capacity of 99,999 and positive action is assured by the construction of the instrument. Skips or overthrow of the number wheels is effectively prevented by a short lever throw of ½ inch. The brass case is cadmium plated and the instrument can be furnished with the operating arm on either the right or left-hand side.

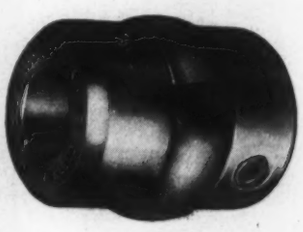


Appearance of counter is enhanced with cadmium plated brass case

Rubber Separates Coupling

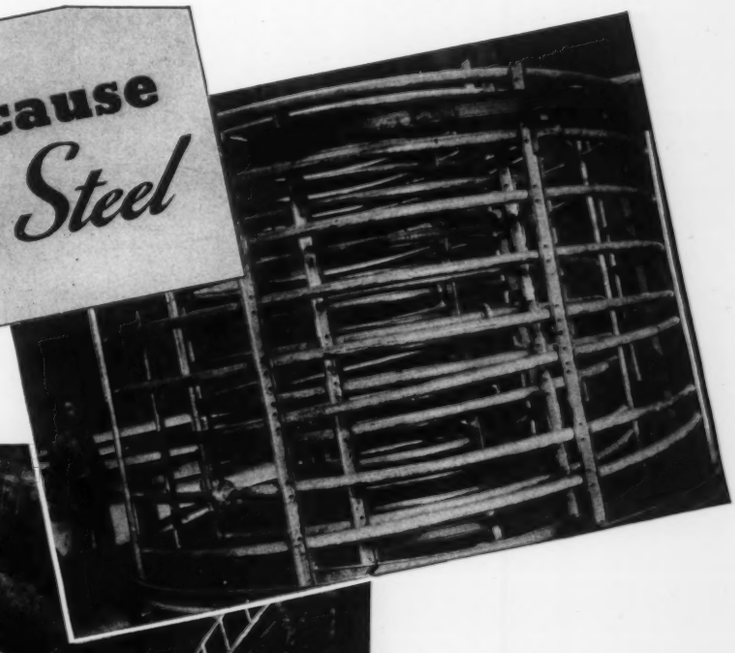
OIL resistant rubber spider used in a new coupling brought out recently by the Certified Flexible Couplings, Inc., 122 East 42 street, New York, permits uniform compression on the insert even when coupling operates under misalignment. The rubber insert provides torsional resilience, torsional flexibility and absolutely quiet operation.

Other claims for the coupling are that its three-piece



Small outside diameter reduces flywheel effect in flexible coupling

Better . . . because it's *Stainless Steel*



The coil alone of this installation in a modern brewery consists of over a thousand feet of 3-inch 16-gage 18-8 stainless steel tubing.

This 38,000-gallon yeast propagator is *better because it's stainless steel!* Tank lining, attemperator coil, aerating system, fittings, ladders—all stainless steel...Stainless steel does not affect the color, taste, or clarity of the brew, nor does the brew affect the steel. Better beer is the result!

In thousands of other applications, stainless steel makes a better product and does a better job. If your product must be cleaner and purer . . . if you want strength, lightweight, corrosion resistance, and fatigue resistance in your equipment, it will pay you to consider the possibilities of stainless steel.

Electromet Metallurgists, through years of practical experience with ferro-alloys and alloy steels, can help you apply stainless steel to your equipment or product. Write for the book "Stainless Steels and their Uses" and learn what already has been done.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

CARBIDE & CARBON BUILDING **Electromet** Ferro-Alloys & Metals 30 EAST 42nd ST., NEW YORK, N. Y.

"We'll have to get these drawings out in a hurry!"

"That's easy—our draftsmen can work 40% faster since we equipped them with BRUNING-WALLACE DRAFTING MACHINES."

"You see, the Bruning-Wallace Drafter saves the time we used to waste in the separate handling of Triangle, T-Square, Scale and Protractor. What's more, the draftsmen are less fatigued at the end of the day."

"Looks like a mighty fine drafting tool!"

"It certainly is—finest on the market today. We bought Bruning-Wallace Drafters because no other drafting machines offer so many exclusive features and advantages."

This *FREE* Booklet Gives You Complete Facts About the Bruning-Wallace Drafter!

Our free booklet, "How to Take the Waste Out of Drafting," may start a new era of efficiency and economy in *your* drafting room. Your copy is waiting—mail the coupon for it!

BRUNING Since 1897

—A nation-wide service in sensitized papers, reproduction processes, drawing material and drafting room equipment.

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CHARLES BRUNING COMPANY, Inc., 102 Reade St., New York, N. Y.
Gentlemen: Please send me your FREE booklet,
"How to Take the Waste Out of Drafting."
Name ..... Company .....
City ..... State .....

773

construction makes for simplicity, it operates efficiently under misalignment, requires no lubrication, and due to its small outside diameter is proof against flywheel effect. Power loss through the coupling is almost negligible, according to the makers. The couplings are available in a number of different sizes and bores.

Announces New Linestarters

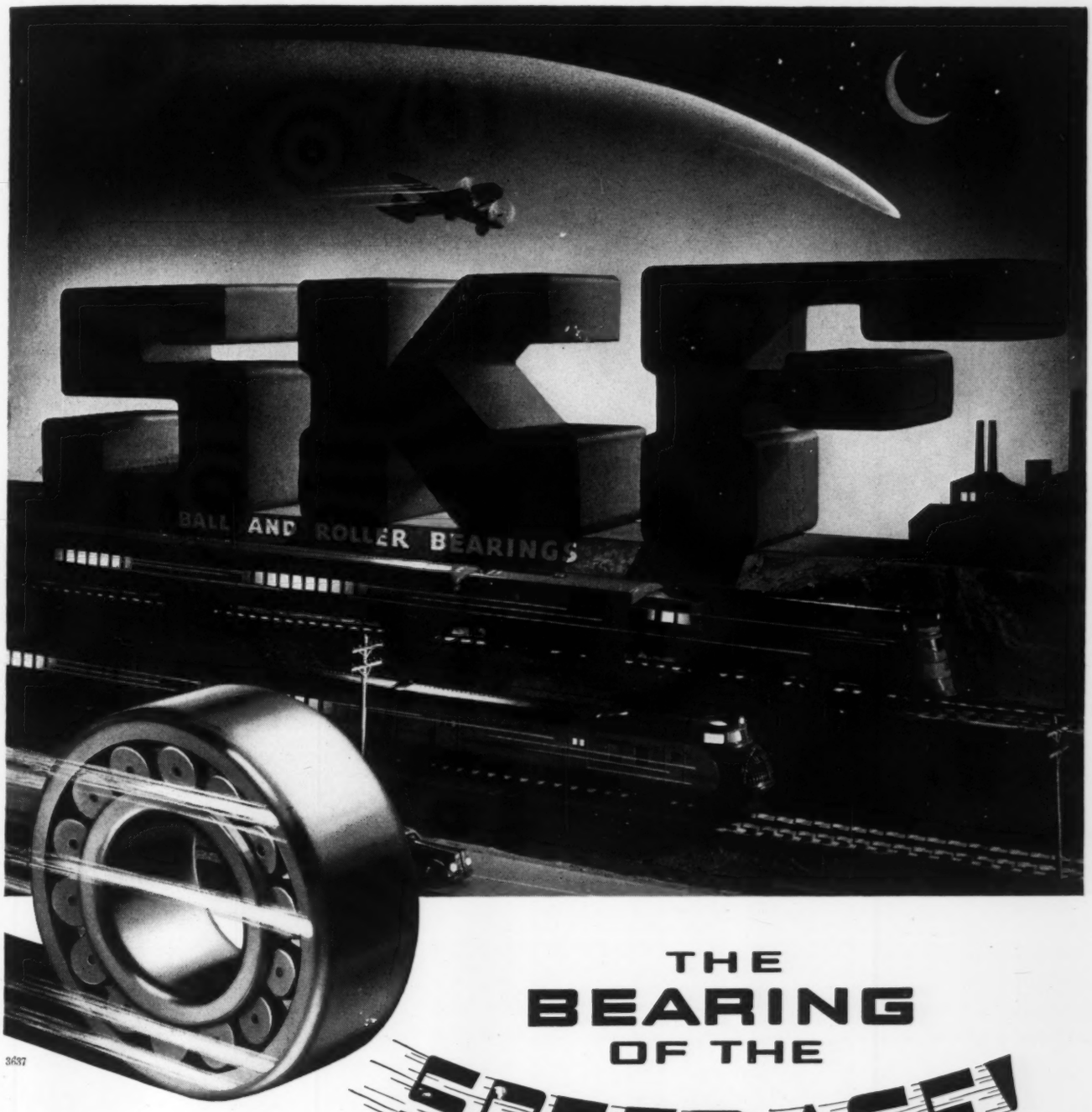
MIDGET contactors and linestarters comprise a line of remote controlled, reversing and non-reversing magnetic starters for small single-phase and polyphase squirrel cage induction motors brought out by the Westinghouse Electric & Mfg. Co., Pittsburgh. The non-reversing contactors are particularly adapted for use with small motors driving air conditioning equipment, compressors, pumps, oil burners, domestic stokers and machine tools.

Coin silver contacts provide long life and maximum conductivity in these contactors and linestarters and a thermal overload relay affords adequate protection. The operating mechanism is mounted on an insulating base and may be removed as a unit from the cabinet. The contactors are available for ½ horsepower at 110 volts or one horsepower at 220 volts to be used either as a remote-controlled line switch or as a motor starter. Both reversing contactors and reversing linestarters are offered in several sizes ranging from one horsepower, 110 volts, three phase, to one horsepower, 220 volts, single phase.

Operating mechanism in this linestarter is mounted on insulated base and may be easily removed from cabinet

Counters Are Electrically Driven

ELECTRICAL counters available with five digits in either the reset or non-reset types have been announced by Struthers Dunn, Inc., 139 North Juniper street, Philadelphia. Construction of the counters is such that the load on the operating mechanism is constant regardless of what number is being counted which is accomplished by gearing the indicating wheels together as is done on a watt hour meter. The duty of the operating mechanism is much the same as on a relay since the load does not vary according to the num-



THE BEARING OF THE SPEED AGE!

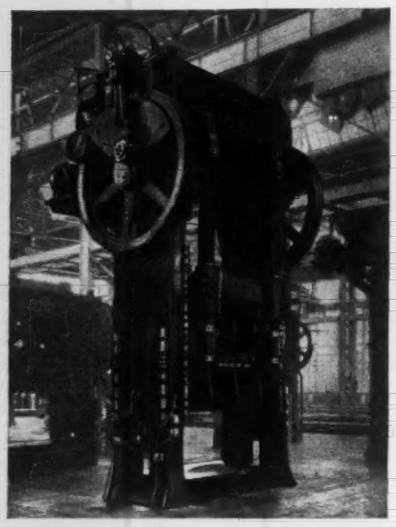
THE great meteor streaking in fiery radiance across the skies sets the pace—and the world strives to keep up. New planes rocket through space. New cars fly along the highways. New trains flash across the rails. It is The Age of Speed . . . and speed takes heavy toll of bearings that are unfit!

Most any bearing will serve on a lumbering ox cart. But when it comes to Speed, engineers everywhere put their bearing problems squarely up to SKF. The finest of selected and specially processed steels go into SKF Bearings. The greatest of the world's anti-friction engineers are engaged in their designing. And only after the most vigorous laboratory tests does an SKF Bearing earn the right to its name.

Always make sure of the bearings in anything you buy, build or design. Specify SKF for all-around bearing performance.

SKF INDUSTRIES, INC., Front Street and Erie Avenue, Philadelphia, Pa.

HOW ABOUT THOSE "hard-to-get-at" BEARINGS?



★

. . . they *May* be some of the most important on the Machines you design

★

INSTALLING Farval Centralized Systems of Lubrication on the machines you design and build is assurance to your customers that every bearing—even the most hard-to-get-at—will receive *regular* attention.

The Farval System is a mechanical method of delivering a predetermined, measured quantity of lubricant, under high pressure, to a group of bearings from one central station. Each receives the correct amount of lubricant, and not a one is missed.

Farval Systems quickly pay for themselves through: reduced labor of oiling—reduced power consumption—increased life of bearings—and by eliminating waste of lubricant.

They increase production by reducing outage time; and also prolong life of equipment.

Design Engineers are invited to write for complete information and technical data. The Farval Corporation, 3265 East 80th St., Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

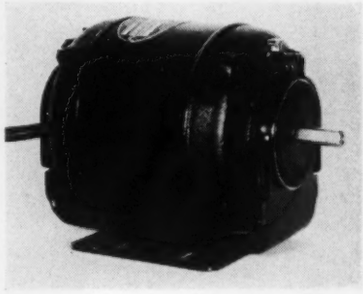
CENTRALIZED SYSTEM OF LUBRICATION

Special Delivery to Every Bearing

ber being counted. The counters are suitable for applications on most machines where electric power is available.

Announces New Motor Line

INTRODUCTION of a series of split-phase motors ranging in size from 2⅝ to 6 inches in diameter has been announced by Delco Appliance division, General Motors Sales Corp., Rochester, N. Y. Design features which distinguish this new line of motors are: oversize, wick-packed oil reservoirs, wide use of special alloys,



Oversize, wick packed oil reservoirs distinguish this split-phase motor

closer than average clearances, special insulating varnish to prevent grounds and short circuits in the windings, dynamic and static balancing of rotors and resilient mountings which are impervious to oil and water. The motors are available in ratings from 1/200 to ⅛ horsepower.

Heat Resistant Plastic Developed

PLASTICS with a higher heat resistance than the ordinary have been developed by General Plastics Inc., North Tonawanda, N. Y. The improved thermosetting phenolic resins in both liquid and powdered forms are designed for numerous industrial bonding applications. Certain types when used with rubber and drying oils give the finished product a higher heat resistance, more strength and a uniformly stable coefficient of friction. Other resins in this series are used to improve the properties of fixed resistance units or the bonding of cork in the production of more flexible and heat resisting gasket stock.

Rollers Suited for Heavy Loads

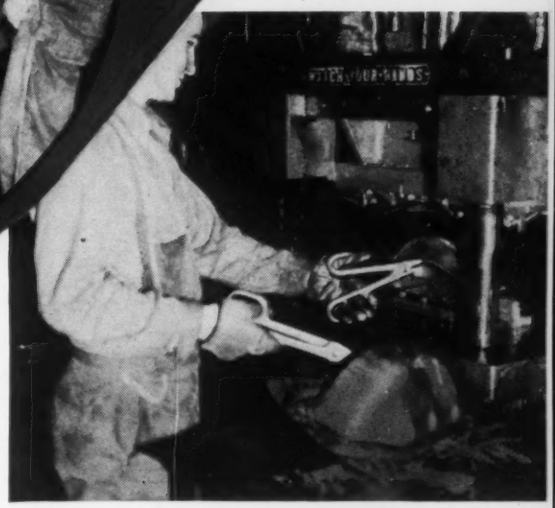
DESIGNED for heavy duty service, two types of ball bearing rollers have been brought out by the Mathews Conveyer Co., Ellwood City, Pa. Both designs incorporate self-contained double seals which protect the ball bearings and races from foreign matter and are mounted on hexagon axles which prevent the inner

LIGHTNESS *Leads*

TO GREATER SAFETY

Safety combined with lower manpower is gained with this material handling rack made of Dowmetal. Weighing only 125 lbs. it carries 15 tons of sheet steel. Two workers handle it with ease. Built of steel, it would require four men with greater accident hazard.

Safety blocks made of Dowmetal have replaced the former wood type in this leading automobile factory. Far greater strength and safety are secured, yet the blocks are easily handled by workers. Depending on size, these Dowmetal safety blocks withstand dead weights ranging from 60 to 500 tons.



Another important safety application utilizing the unique lightness of Dowmetal is its use in material handling tongs. Being exceptionally light, yet strong and durable, workers use these tongs throughout the full working day with minimum fatigue.

And DOWMETAL *PASSES ALL OTHER PRACTICAL METALS IN LIGHTNESS BY 33⅓%*

The benefits of super-lightness made possible with Dowmetal reach forward in many directions.

Possessing a lightness superiority of a full third over aluminum, Dowmetal is accomplishing exceptional results.

In both products and processes, Dowmetal is fast taking a front-rank position.

It makes manual handling far easier as notably demonstrated in the new Hoover Electric Cleaner, various brands of portable tools, foundry flasks and numerous other products.

It is saving power and giving a higher performance factor in such equipment as air conditioning systems, automatic wrapping machines, textile looms and printing presses.

It is showing the way to greater pay loads—especially in aircraft, trucks and buses.

It is even promoting greater safety through such uses as safety blocks, light weight tongs and material handling equipment.

Dowmetal is produced in plate, sheet, forgings, sand or die-castings, standard or special extruded shapes. It conforms to all usual methods of metal fabrication.

Investigate the characteristics, uses and advantages of Dowmetal. It is doing many things for many manufacturers—speeding production methods or giving products a unique lightness advantage.

Let us send you, without obligation, "The Dowmetal Data Book" which covers the whole subject of Dowmetal—its characteristics, uses and methods of fabrication.

THE DOW CHEMICAL COMPANY · *Dowmetal Division* · Midland, Michigan

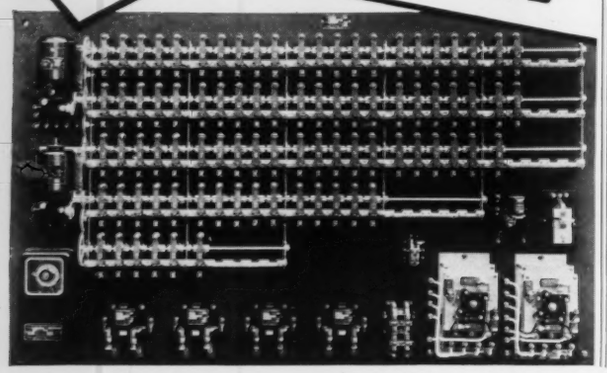
DOWMETAL

MAGNESIUM ALLOYS

LIGHTEST OF ALL STRUCTURAL METALS

The World's Largest
"Spectaculars" use...

BODINE MOTORS

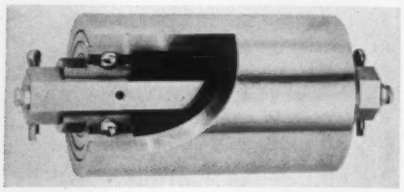


• These huge Canadian Club, Seagram's, and Burlington Zephyr electric signs—known as "spectaculars"—are operated by Sangamo flasher panels equipped with Bodine motors. Some of these motors operate continuously, others intermittently, all night long, starting and stopping with every series of flashes. Although the service is severe, these Bodine motors have been giving reliable, trouble-free performance.

Bodine motors are being used on hundreds of special machines, where the load requires a motor "tailored" for the job. For over 30 years, Bodine engineers have been designing motors to meet individual load requirements. They can help solve your motor problems. Write Bodine Electric Co., 2258 W. Ohio St., Chicago, Ill.

BODINE
FRACTIONAL H. P.
MOTORS
ENGINEERED FOR YOUR PRODUCT

ball race from rotating on the axle. Other features of the rollers include the pressed steel jackets around the outer bearing races in the type 63SB bearing, rollers of seamless steel tubing, grease fittings, and broached



Double seals protect bearings in roller from dust and dirt

hardened inner races. Load ratings per roller range from 3000 pounds on the smaller model to 8000 pounds on the 105SB model. Each is supplied in several different sizes.

Starting Switch Is Offered

SUITED for single-phase alternating current squirrel-cage motors driving machine tools, fans, blowers and other small machinery, Cutler-Hammer, Inc. has brought out a new pushbutton-operated, motor-starting switch. It is adapted to all small machinery where a two-pole starting switch with thermal overload pro-

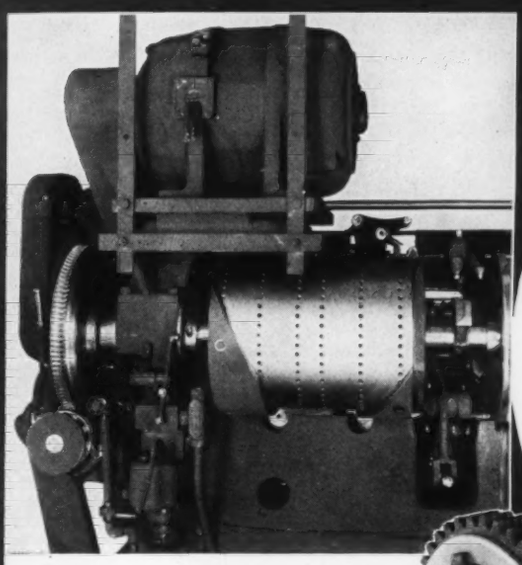
Starting switch automatically resets itself after being tripped by overload

tection is desired. The mechanism is enclosed in an air-styled case which provides inverse time limit overload protection both in starting and running, allowing ample time to take care of starting inrush and momentary overloads without tripping. It automatically resets itself when the circuit has been opened by an overload and the motor can be restarted by simply pushing the "reset" button.

Controller Is Self-Operated

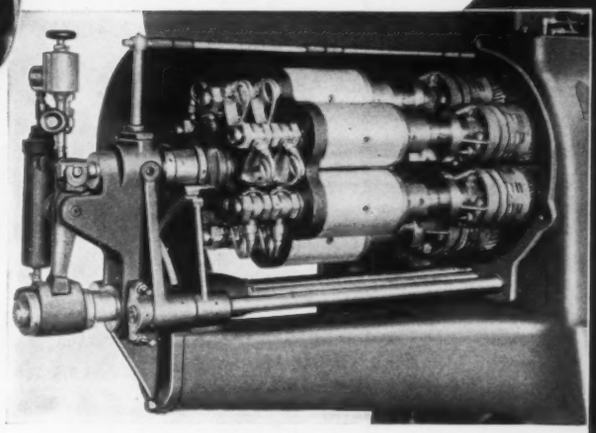
EXACT temperature control is assured with the improved self-operating controller recently announced by the C. J. Tagliabue Mfg. Co., Park and Nostrand avenues, Brooklyn, N. Y. Designed for close control where auxiliary power is not available or where steam pressure is less than 10 pounds per square inch, the

Fast, flexible operation built-in with TWIN DISC CLUTCHES



Feed Brake of Cleveland *Model K Multiple Spindle Machine, showing Twin Disc Clutch directly under the worm wheel at the extreme left end of the machine. Another Twin Disc, in the feed drive, engages the high speed and working speed motion.*

Twin Disc Single Close Coupled Dry Type Clutch



Twin Disc Clutch assembly in the stop spindle of Cleveland chucking *machines. Clutch is automatically disengaged in the upper front or loading position and automatically engaged again as the spindle turret indexes.*

● Present-day production economies depend upon fast, flexible operation—and it must be built-in with the controls.

The Cleveland Automatic Machine Co., Cleveland, Ohio, find that Twin Disc Close Coupled Multiple Disc Clutches have improved the operation and increased the efficiency of *Cleveland* Automatic Chucking, Boring and Screw Machines. They chose Twin Disc particularly because of its simplicity of adjustment and sturdy construction. And, being more easily installed, it has simplified their design.

All parts in these close coupled model clutches are accurately machined and carefully finished to be suitable for use on the highest grade machine tools. Contacting friction surfaces are of hard phosphor bronze and tempered saw steel. Operating parts are heat treated to obtain maximum strength and hardened surfaces, thus insuring continued service with a minimum of maintenance. Made in 2½ in. to 12 in. sizes, in either single or duplex construction, oil or dry type. All sizes have positive locking, single point adjustment. Plates may be adjusted as little as .003—an important feature, since it provides maximum capacity with lowest operating pressures.

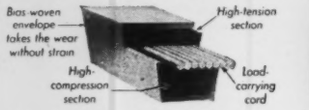
Write today for specific recommendations. Engineering data on request.

TWIN DISC CLUTCHES

TWIN DISC CLUTCH COMPANY
1325 Racine Street
RACINE • WISCONSIN

Greater Design Flexibility...
Maximum Belt Drive Economy

WORTHINGTON
MULTI-V-DRIVE
with
GOODYEAR
EMERALD CORD BELTS



HIGH LOAD CAPACITY
LONG FLEXING LIFE

- Advanced belt design
- Accurate sheave grooves
- Balanced sheave rotation
- Moisture and shock proof

25,000 STOCK COMBINATIONS
...UNLIMITED SPECIALS
Fractional to 1500 horsepower

A New Handbook
of Multi-V-Drive
Selection Tables
and Engineering Data
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Send me a copy of the Handbook of Multi-V-Drive Selection Tables and Engineering Data.
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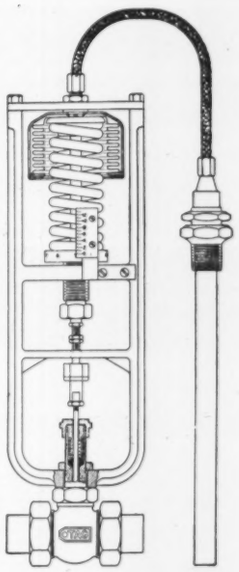
new unit operates entirely from the temperature change at the sensitive element in the apparatus. Rugged construction of the thermostatic system and a practically



Power for actuating valve in thermostat is supplied by expansion and contraction of fluid in sensitive element

frictionless and self-adjusting stuffing box makes the controller suitable for applications under severe service.

Rubber Plug Has Many Uses

MADE of unbreakable soft rubber, a new plug suitable for use with machine installations has been announced by the Belden Mfg. Co., 4689 West Van Buren street, Chicago. The plug has been molded in an

Molded rubber plug has no parts that might be lost or broken

attractive design with a minimum of parts and is suitable for use with radios, fans or motors driving small appliances, or any applications where house current is used. Simplified construction makes the plug economical and easy to adapt to particular needs.

Governor Is Oil Operated

CONSTANT speed in a prime mover is maintained with a new oil relay governor made by The Pickering Governor Co., Portland, Conn. Regardless of variations in the load imposed on the prime mover the gov-

The Aristocrat of Bearings

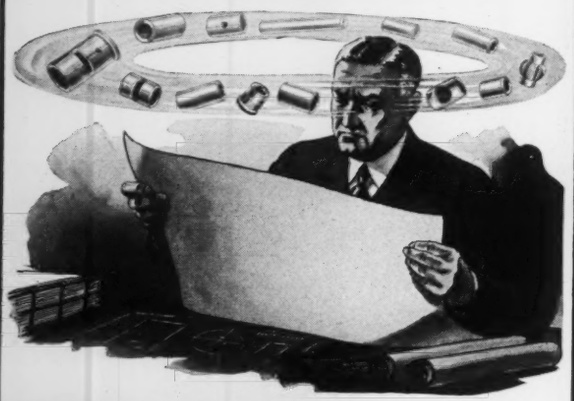
"Just Beautiful" is the only way their mechanical excellence can be described.

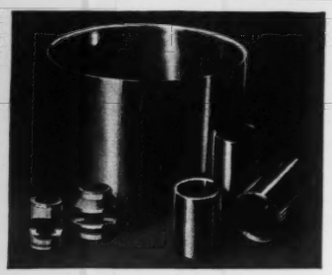
HOOVER
BALL AND TAPERED ROLLER
BEARINGS

HOOVER
BALL AND
BEARING
COMPANY

ANN ARBOR • MICHIGAN

WHEN BEARINGS BOTHER...





BUNTING'S *unmatched production control facilities assure exact chemical analysis together with the maximum of desired physical properties. Patterns and tools for over 30,000 different designs are placed free at our customer's disposal. Let us quote on your requirements.*

MANY a manufacturer, engineer or superintendent has found that he saves time and money as well as worry by calling on Bunting when bearing specifications are being considered. Here, at your command, are the vast experience acquired through infinitely various applications and the knowledge gained through long-continued, comprehensive research involving alloys, designs and lubrication problems. . . Here are engineering, metallurgical and research staffs of outstanding ability. We can tell you which bearing to specify and why. This collaboration costs you nothing. Neither does it commit nor obligate your freedom in purchase. Simply ask for it. The Bunting Brass & Bronze Company . . . Toledo, Ohio. Branches and Warehouses in All Principal Cities.

BUNTING Bearing **Quality**

BRONZE BUSHINGS • BEARINGS
MACHINED AND CENTERED BRONZE BARS
ANTI-FRICTION BABBITT

ernor controls the speed to a constant value. The slightest change from the set speed of the prime mover is immediately corrected by the governor which allows any changes to be only momentary. Optional equipment includes remote control by means of reversible electric motors, throttle limit, adjustable speed droop, vertical or horizontal drive and automatic shut down for any pre-determined cause.

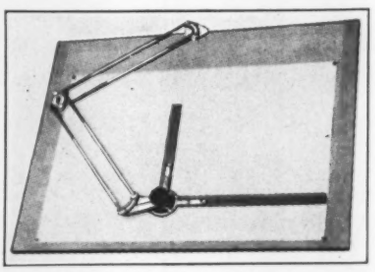
Rubber Coupling Permits Flexibility

MOLDED rubber is used entirely in a flexible coupling for low horsepower recently introduced by Henry Engineering Co., Moline, Ill. Extra strength and durability are built into this coupling, according to the manufacturers, by a special compound flexible rubber. It is flat spot molded to fit the shaft securely and does not require any keyways or set screws. The coupling can be built in various lengths to fit any kind of shaft.

Engineering Department Equipment

Drafting Machine Features Precision

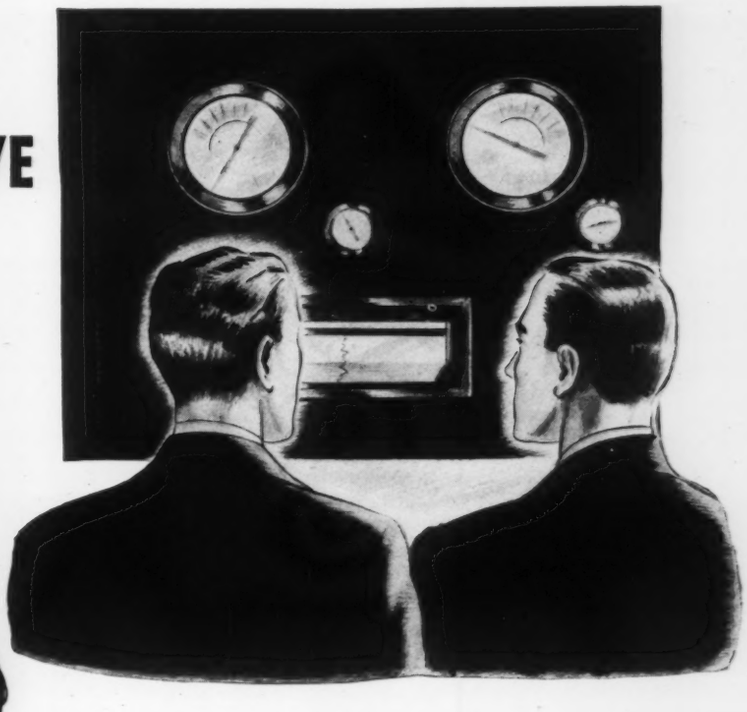
DRAWINGS up to 28 by 38 inches can be easily made on a new precision drawing instrument, model R-300, being sold through the Wrigraph Sales Division, 5209-14 Euclid avenue, Cleveland. Ball bearings which are prelubricated and sealed at the factory insure easy movement and accuracy while aluminum alloy castings make the drafting machine light. The indicating protractor is of a new type with which one-degree angles are obtained in a single simple



Prelubricated ball bearings insure accuracy and easy movement in this improved drawing instrument

operation. Graduated drawing edges on the scales are made of transparent pyralin and a scale chuck plate adjustment provides for perfect right angle alignment. An attractive mounting clamp holds the machine on any drawing board and the machine is self leveling. Rugged construction makes the machine particularly suited for constant, severe service.

THE SWITCH IN THIS SUPER-SENSITIVE CONTROL IS A...



KON-NEC-TOR

Mercury Switch

The heart of the mechanism that allows one manufacturer to build zone heating controls that respond to pressures as low as 1/10 oz. is a General Electric KON-NEC-TOR Mercury Switch. These zone heating regulator controls were originally designed with metal switches but frequent opening and closing caused sparking and resulting pitting of the metal, causing the control to fail. KON-NEC-TORS replaced the troublesome metal switches and responses to a movement as small as .006 inch in the diaphragm pin are now taken as a matter of course.

This experience is typical of that of other manufacturers who demand maintenance-free switches that will function indefinitely without needing repair. Wholly glass-enclosed and safe from corrosive fumes or gases, KON-NEC-TORS also make an ideal emergency switch. Send for information on the application of KON-NEC-TORS on your equipment. Write for complete details to the General Electric Vapor Lamp Co., 825 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

785-K

You can do better with McGILL MULTIROL

The Precision Needle Bearing

FOR great load capacity in small radial space, nothing equals McGILL MULTIROL Precision Bearings—they're patented. Especially under sustained heavy or intermittent shock loads they far outrun plain bearings and frequently other anti-friction types—proven in thousands of installations since their introduction eight years ago.

McGill *MULTIROL* Bearings are made in many designs, adaptable to many different applications in practically every type of equipment requiring radial bearings. Stocked in standard sizes from ⅝ to 6-inch bore, single and double rows of rollers, at low, volume production prices. Corrosion and heat resisting types, and special designs gladly engineered to individual needs.

Send for Bulletin No. 37

McGILL MANUFACTURING CO.
Bearing Division, 1450 N. Lafayette St.
VALPARAISO, IND.

MEETINGS *and* EXPOSITIONS

Mar. 16-18—

American Railway Engineering association. Annual meeting to be held at the Palmer House, Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary.

March 21-27—

American Ceramic Society. Annual meeting to be held in New York. Ross C. Purdy, 2525 North High street, Columbus, O., is secretary.

Mar. 23-26—

American Management association. Packaging, packing and shipping conference and exposition to be held at Pennsylvania hotel, New York. Alvin E. Dodd, 330 West Forty-second street, New York, is president.

April 5-10—

Southern Textile exposition. Twelfth Southern textile exposition and exhibit to be held at Greenville, S. C. Additional information can be obtained from P. C. Sowersby, General Electric Co., Schenectady, N. Y.

April 21-23—

Society of Automotive Engineers. National tractor meeting to be held at Pere Marquette hotel, Peoria, Ill. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary and general manager.

May 3-7—

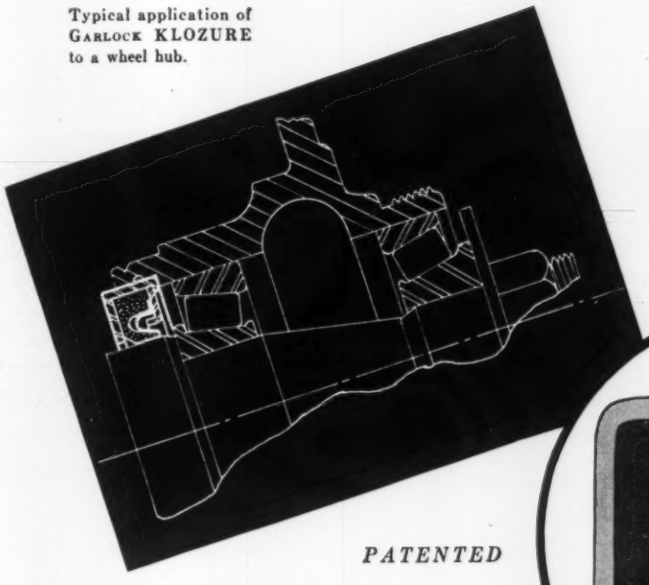
American Foundrymen's association. Forty-first annual convention and show, to be held in Milwaukee. W. F. Bornfleth, care of Cutler-Hammer Inc., Milwaukee, is general chairman.

June 21-July 16—

Massachusetts Institute of Technology. Special summer school and conferences on "Strength of Materials," to be held at Massachusetts Institute of Technology, Cambridge, Mass., for four weeks beginning June 21. Prof. John M. Lessells, Department of Mechanical Engineering, Massachusetts Institute of Technology, is director of the summer school.

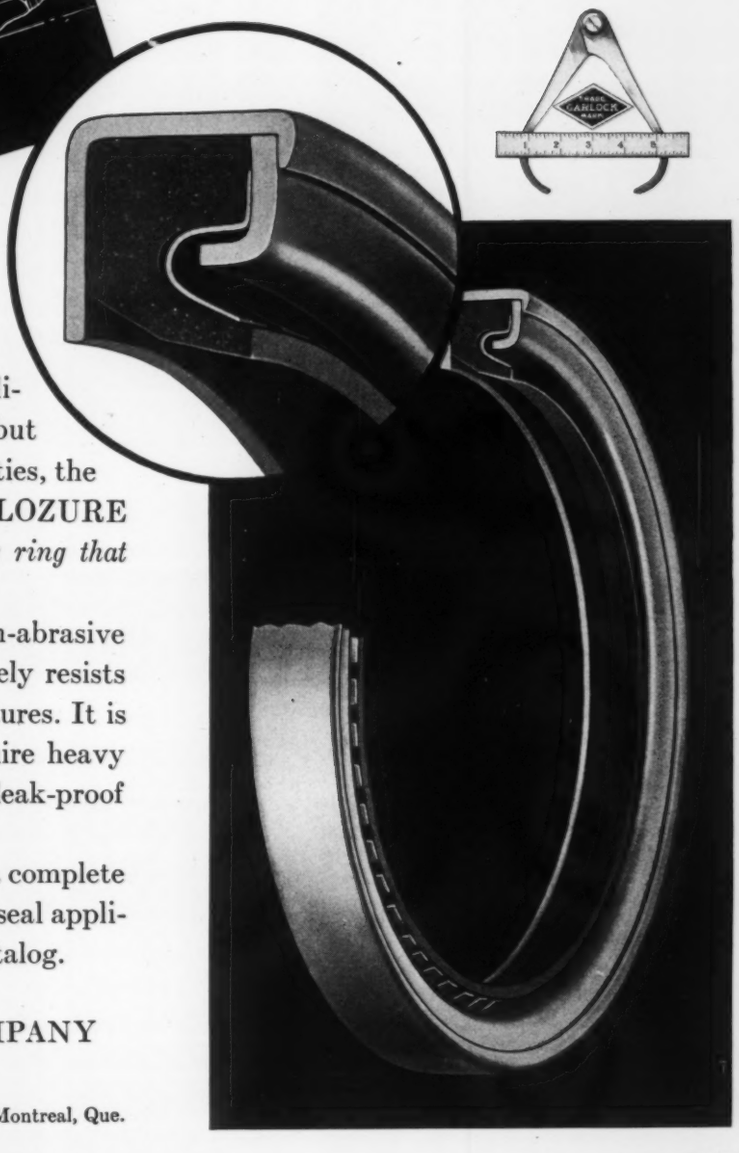
HERE'S THE SEALING RING THAT "RINGS TRUE!"

Typical application of GARLOCK KLOZURE to a wheel hub.



THE *Garlock* KLOZURE

PATENTED



COMBINING *all* the desirable qualities of felt, cork and leather, but having none of their undesirable qualities, the sealing element in the GARLOCK KLOZURE well deserves being called the *sealing ring that "rings true."*

Dense, grainless, non-porous and non-abrasive —the KLOZURE sealing ring effectively resists water and oil at high or low temperatures. It is inherently resilient and does not require heavy spring loading in order to maintain leak-proof contact with the shaft.

GARLOCK KLOZURES are made in a complete range of sizes and for every type of oil seal application. Write for new KLOZURE Catalog.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Co., of Canada, Ltd., Montreal, Que.

SEALS HERE
by bronze ring pressing against bearing race or shaft shoulder.
GITS
SPRINGS
give evenly distributed pressure on bronze seal ring.
PAT. APPL'D FOR
SPEED
OIL SEAL
GUIDE PINS sliding in wells in housing to avoid torsional strain on diaphragm.
DIAPHRAGM of oil and waterproof fabric resists heat up to 220° F., Metal used for constant temperatures above 220° F.

Engineering data furnished on request

GITS BROS MANUFACTURING CO.
1861 S. KILBOURN AVE., CHICAGO

Use No. 8 VANE
for circulating oil for coolant or lubrication
...inexpensive
...compact

Ask for Catalog on Geared, Vane and Centrifugal Pumps.

—dependable
—steady flow
—simple construction
—runs in either direction

Brown & Sharpe Mfg. Co.
Providence, R. I.

BROWN & SHARPE PUMPS

B·S

MANUFACTURERS' PUBLICATIONS

ALLOYS (NICKEL)—"Strength Plus — Monel for Mechanical Jobs", which was prepared by the Monel and rolled nickel division of International Nickel Co., Inc., 67 Wall street, New York, covers in an interesting manner the story of nickel-copper alloy, including technical facts and data given in charts and tables, and the use of Monel as applied to various fields.

ALLOYS (NICKEL)—Nickel alloy steels as applied to petroleum production equipment is the subject discussed in a bulletin recently announced by International Nickel Co. Inc., 67 Wall street, New York. Characteristics of the alloys are covered specifically.

ALLOYS (STEEL)—"The Steel Handbook", published by Union Drawn Steel Co., Massillon, O., contains a collection of data designed to aid the steel user in selecting the right steel for the right purpose.

BEARINGS—Catalog No. 10, recently published by Auburn Ball Bearing Co., 28 Industrial street, Rochester, N. Y., will aid in the selection of the proper ball bearings for a specific purpose, as it includes descriptions and illustrations of the many types of ball bearings manufactured by the company, the sizes in which they are available, and applications.

CAST STEELS—Cast steel for various parts to be used in machines is discussed in two folders being distributed by Farrell-Cheek Steel Co., Sandusky, O. Illustrations show numerous applications, and types and sizes available of these parts. Characteristics of the different grades of this steel, manufactured by the company, are given.

CONTROLLERS (ELECTRICAL)—Specifications of self-operating temperature controllers manufactured by C. J. Tagliabue Mfg. Co., Park and Nostrand avenues, Brooklyn, N. Y., are given in detail in the illustrated bulletin, No. 1142, recently issued by the company.

CONTROLS (ELECTRICAL)—List prices, characteristics and applications of all types of electrical switches and specialties are covered in Catalog No. 23 of Harvey Hubbell Inc., Bridgeport, Conn. Numerous illustrations and tables of these various parts will immediately give one information as to type and size available of each.

CONTROLS (ELECTRICAL)—Major features of the two new series, Nos. 110 relays, for alternating current

This may look like a

LOT of SPRINGS

to you

but **these are only a few of the different kinds of springs we make!**

AMERICAN Quality Springs are made to meet any requirement. We make springs of every size and description from the tiny springs that must be observed under a magnifying glass to some of the mightiest springs in use.

Our engineers and designers are frequently called upon to work out difficult problems which involve springs of unusual design to meet unique conditions. These men are available to help you out of any difficulties you may have.

Whether the springs you use are compression, extension, torsion, or special, we are prepared to meet your needs with springs that have a reputation for strength, uniformity and skill in production. No matter what your requirements in springs may be, you can look to American Quality Springs to answer them economically and to your complete satisfaction.

U·S·S AMERICAN QUALITY SPRINGS

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago

Empire State Building, New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

—Solderless—

DOWN —Tapeless— GO

PRODUCTION COSTS with

IDEAL

WIRE CONNECTORS

Twist onto the bared ends of wires just like twirling a nut onto a bolt. Result—a perfect electrical connection, a strong mechanical joint. One man does the whole job, quick. Lower cost than unsightly solder-and-tape joints, binding posts, and plug terminals. Great time savers in experimental and production work. A size for every wire joint. A *permanent*, dependable joint.

Fully approved. Listed by Underwriters' Laboratories.

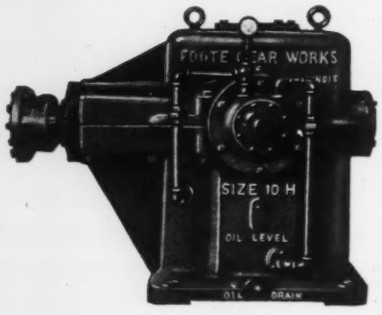
Write for Samples

IDEAL COMMUTATOR DRESSER COMPANY
1059 Park Ave., Sycamore, Illinois

SPEED REDUCERS

SPIRAL BEVEL GEAR REDUCER

Size 10 B. H.
Ratio 1¾ to 1
75 H.P.
500 RPM
CONSTANT DUTY
STEEL MILL SERVICE
WITH PRESSURE LUBRICATION



Installed by Worthington Pump and Machinery Corp.—Between a Diesel engine and Duplicate reciprocation power pump in a job at Artesian, New Mexico.

FOOTE GEAR WORKS, INC.
Cut Gears Of All Kinds.
1301-G. S. Cicero Av., Cicero, Ill.

service, and 115 relays for direct current service, are covered in a bulletin prepared by Guardian Electric Mfg. Co., 1625 West Walnut street, Chicago. In addition to the standard screw type mountings, the new relays are supplied mounted on Bakelite bases, wired to terminals, or with a Bakelite base and black enamel cover.

CONTROLS (ELECTRICAL)—Leaflet No. L 20568-A, listing the Class 11-220 line of midget contactors and linestarters is being distributed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Sizes available, construction and control circuits for these contactors and linestarters, both reversing and non-reversing, are given.

CONTROLS (ELECTRICAL)—Major features of a new thermal overload switch for fractional horsepower motors, designed to operate on line current and arranged for mounting on the conduit or terminal box of the motor, are given in a release of General Electric Co., Schenectady, N. Y.

CONVEYORS—Integrally cast stoker screws are described and illustrated in a recently issued folder of Farrell-Cheek Steel Co., Sandusky, O. These screws are made from a special wear-resisting screw steel available in sizes to meet individual needs.

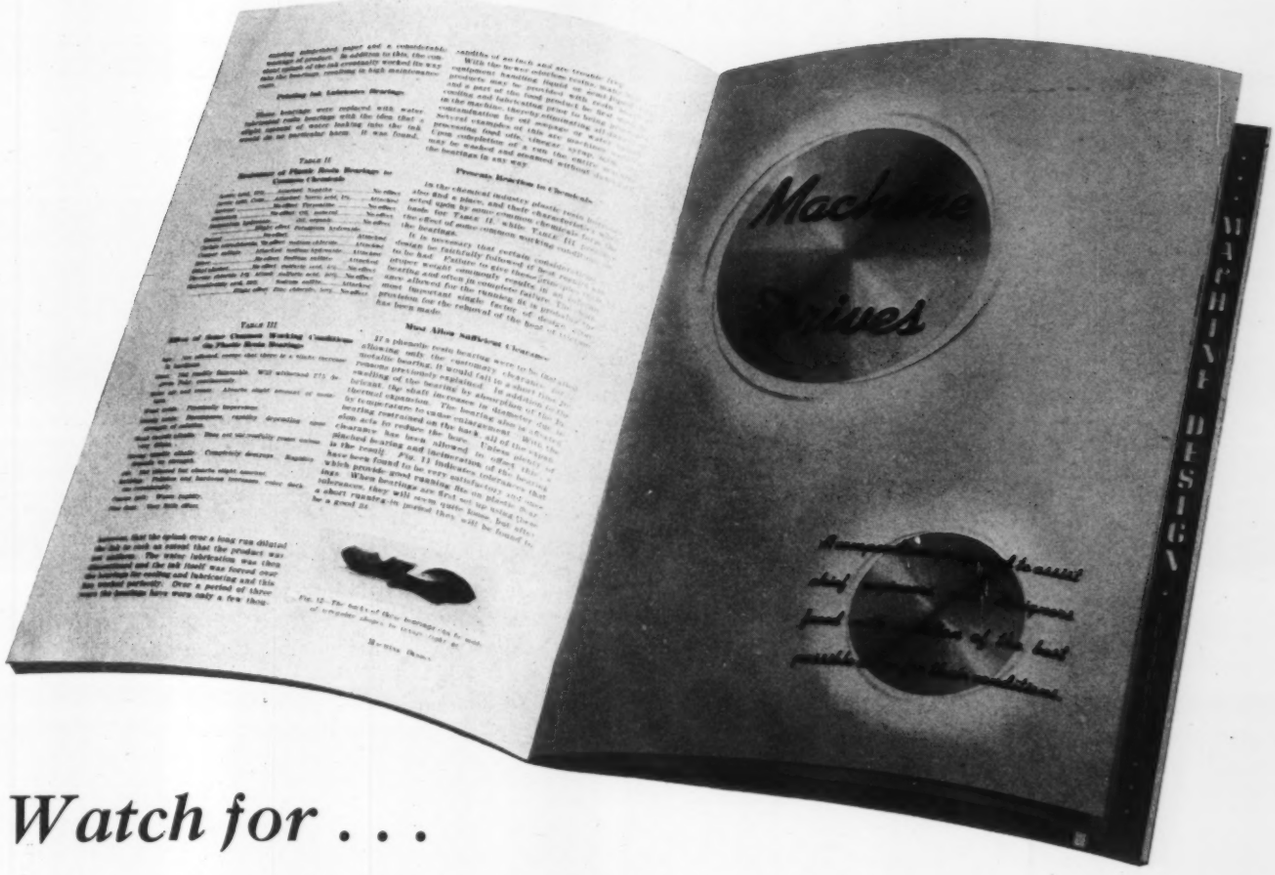
COUPLINGS—John Waldron Corp., New Brunswick, N. J., has just issued a two-color bulletin describing and illustrating its new line of Francke fractional horsepower flexible couplings, which are designed for fuel pumps, generators, fans, etc.

DRIVES—Universal Gear Co., Indianapolis, has issued a folder on its Heliocentric reduction units capable of giving reductions of 20-1 to 80-1 in a single stage. Illustrations show various applications of the unit.

FASTENINGS—Socket head cap screws, hollow set screws, socket head stripper bolts, wrenches, etc., are described in an illustrated bulletin of Standard Pressed Steel Co., Jenkintown, Pa. Descriptive matter on the foregoing includes characteristics, applications and types and sizes. List prices are also given.

FASTENINGS—Just as the title—"'Bolts' for special purposes of special materials or special design, or both, engineered for special applications"—indicates, bolts of various types for many uses are described and illustrated in a folder recently issued by Lamson & Sessions Co., Cleveland.

FASTENINGS—Now available for distribution is the 1937 catalog of Pheoll Mfg. Co., 5700 Roosevelt road, Chicago. This 108-page catalog includes descriptive information and latest price lists for screws, bolts, nuts and related items, as well as American Standard screw thread specifications, dimension tables, weight tables and other practical and authoritative information.



Watch for . . .

"MACHINE DRIVES", A SPECIAL FILABLE SUPPLEMENT IN APRIL MACHINE DESIGN

Advertising pages, with maximum visibility, will be of equal interest and importance to engineers responsible for machine design . . . Space reservations should be made at once . . . Final forms close March 26.

• SUPPLEMENTING its thorough coverage of Machine Drives in regular issues, MACHINE DESIGN will present a special filable section devoted to a symposium of articles relating to the most recent and approved methods and equipment for driving machinery.

Every engineer responsible for the design of machines will find in this special filable supplement a wealth of valuable data and information on the selection, application and performance of various types of machine drives. As a permanent addition to the technical files of engineering departments, the "Machine Drives" section will be valuable.

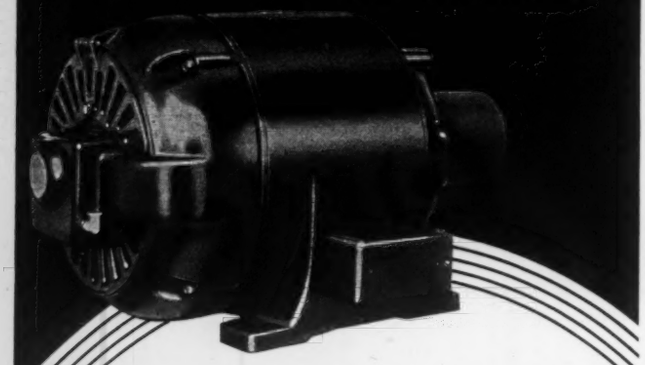
Subjects included in the discussion will be: Machine Drives of the Future . . . Variable Speed Drives . . . Built-in Motors . . . Gears, Gearboxes . . . Magnetic Drives . . . Diesel-Electric Drives . . . Flexible Shafts . . . Hydraulic Drives . . . Floating Motor Bases . . . Air Turbines . . . In all, a veritable encyclopedia of modern machine drives.

MACHINE DESIGN

CLEVELAND, O.

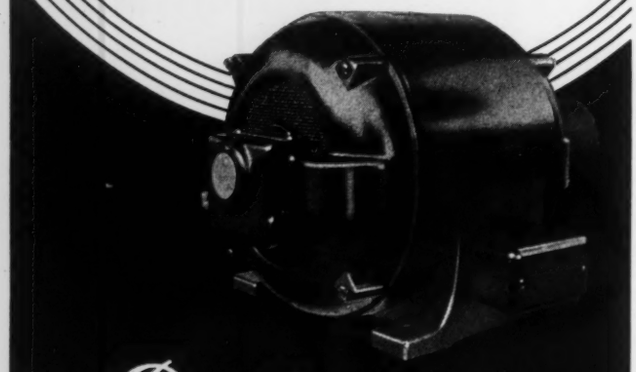
MOTORS

"That have what it takes"



IF YOU are interested in a worthwhile proposition on motors "that have what it takes" come to Peerless.

For more than 43 years Peerless has stood for quality electrical equipment and leading manufacturers of motor driven devices are using Peerless motors because they have confidence in them. They have found through test and experience that these motors carry the load with plenty to spare. ***You can rely on Peerless.***



THE Peerless ELECTRIC CO.
WARREN, OHIO

FINISHES—A new sprayed molten metal coating process is covered in folder No. 1207, recently announced by Metals Coating Co. of America, 495 North Third street, Philadelphia.

HEAT TREATMENT—Current heat-treating and metalworking problems are discussed in a booklet recently prepared by E. F. Houghton & Co., 240 West Somerset street, Philadelphia.

HYDRAULIC EQUIPMENT—Vickers Inc., 1400 Oakman boulevard, Detroit, has issued its bulletin No. 36-10 illustrating its series C2-1237 feed control panel for those hydraulic circuits with which remote control may be used advantageously.

INSTRUMENTS (ELECTRICAL)—Complete data on electrical and mechanical flow meters for indicating, recording and integrating are given in Catalog No. 2004, prepared by Brown Instrument Co., Philadelphia. Illustrations of applications to power plant, water works and gas generation service, as well as to general industrial equipment are shown.

LUBRICATION AND LUBRICATION EQUIPMENT—Alemite Corp., 1812 Diversey Parkway, Chicago, is distributing its 1937 catalog, "Alemite Controlled Lubrication". This two-color, 56-page booklet, which is profusely illustrated with photographs, drawings and diagrams, presents data on the entire range of industrial lubrication equipment such as hand guns, power-operated units, fittings, hose, etc., including a complete section on repair parts.

MATERIALS—Data has been prepared on "synthetic rubber" by E. I. du Pont de Nemours & Co., Wilmington, Del. Detailed information on the discovery of Neoprene, its manufacture, application, commercial development, and significance to science and industry are some points of interest discussed in this booklet.

PNEUMATIC EQUIPMENT—Operating valves for the control of single and double-acting air cylinders as used on machines are covered in Catalog No. 36, issued by Ross Operating Valve Co., 6488 Epworth boulevard, Detroit. These valves are manufactured for hand, foot, mechanical and electrical control.

RUBBER—United States Rubber Products Inc., 1790 Broadway, New York, is presenting a catalog embracing its line of hose. A section is devoted to hose couplings and fittings.

TUBING—A folder illustrating typical step-taper sections and how diameter of tube and wall thickness can be reduced as desired by the designer is being distributed by Summerill Tubing Co., Bridgeport, Conn.

The wise buyer—CONSIDERS ROLLWAY

And when the load is dominantly radial or dominantly thrust, he chooses Rollway. Remarkable increases in bearing life and performance have been made by engineers who have studied their bearing problem in the light of our specialized engineering experience. We will gladly show you where Rollways can help you.

ROLLWAY BEARING CO., INC., SYRACUSE, N. Y. *Factory Representatives* in—Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, and Youngstown. *Agents:* Houston, Texas; Tulsa, Okla.; Birmingham, Ala.; Los Angeles, San Francisco, Portland, and Seattle.

CYLINDRICAL ROLLER

ROLLWAY BEARINGS

RACINE

Variable Volume Hydraulic Pump

A thoroughly proven, efficient pump for power transmission.

Capacities—
0 to 2000
0 to 4000
0 to 6000
cu. in. per min.

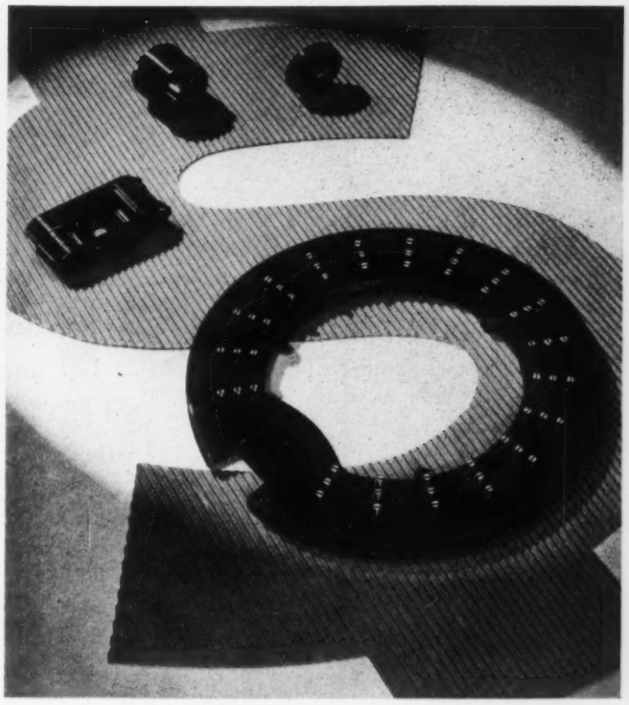
The variable volume feature eliminates by-passing of surplus oil, decreases heating and reduces horse-power requirements. Rated for pressures up to 1000 pounds per square inch.

Successfully applied and proven highly satisfactory on such applications as:

Presses
Die Casting Machines
Welding Machines
Chucking Operations
Machine Tools
Table Movements
Stokers
Conveyors
Broaching Machines
Bending and Rolling Equipment, etc.

A variety of valves and controls are available for standard operations

RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.



Save ASSEMBLY DOLLARS

Your Molded Plastic Parts are too important to be bought piecemeal. Different standards of quality, workmanship and finish can raise havoc with production schedules and assembly costs.

For 60 years Auburn has molded plastic parts to just one standard—the precision standard. When you buy from Auburn you get cost cutting precision that saves many an assembly dollar. Parts by Auburn come to you "exactly as specified," yet they cost no more.

End your molded parts problems once and for all—Specify Auburn.

Established 1876

MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N.Y.

Business and Sales Briefs . . . . . .

ACCORDING to an announcement, plans are ready for a five-story addition, costing $200,000 with equipment, to the plant of Washburn Wire Co., 536 East 117th street, New York, manufacturers of round and flat steel wire specialties.

* * *

Formerly sales manager, David O. Wolf has been elected vice president in charge of sales of Apollo Steel Co., Apollo, Pa.

* * *

Otto Harer has been appointed aluminum castings sales manager of Wellman Bronze & Aluminum Co., Cleveland. Mr. Harer formerly was president of Light Alloys Co., Painesville, O.

* * *

Diamond Chain & Mfg. Co., Indianapolis, has appointed Smith-Courtney Co., Seventh and Bainbridge streets, Richmond, Va., to act as distributor for Diamond roller chain and flexible couplings.

* * *

Ralph J. Cordiner, formerly manager, radio sales division, General Electric Co., Schenectady, has been appointed assistant manager, appliance and merchandise department. This department includes, among others, the specialty appliance sales division and construction material sales division.

* * *

Previously in charge of the Detroit office of Defiance Pressed Steel Co., Marion, O., W. Herbert Bretzlaff has been named a vice president of the company.

* * *

Nathaniel B. Randolph has been made vice president in charge of sales, Granite City Steel Co., Granite City, Ill., succeeding L. F. Miller, resigned.

* * *

Ludlum Steel Co., Watervliet, N. Y., has appointed William L. Weaver as manager of stainless steel casting sales. Mr. Weaver has been associated with the company since 1920, and for the past few years has been special representative.

* * *

Penn Metal Co. Inc., Boston, has appointed M. J. McCarthy district manager of its newly opened Philadelphia sales office, located at 2402 Market street. Mr. McCarthy has been associated with the company for the past ten years as sales engineer.

* * *

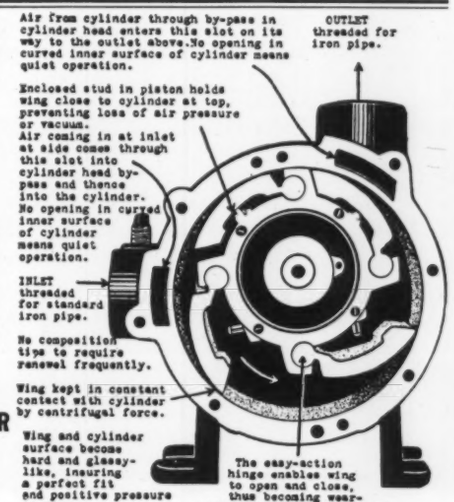
Change in the name of the Bantam Ball Bearing Co., South Bend, Ind., has recently been announced. The new name is Bantam Bearings Corp. This change in name is to describe more clearly its present-day production. Originally when the company was organized forty years ago, the entire business was devoted to the pro-

THOSE HIDDEN COSTS...NOW ARE
PROFITS!
The correct oil film to each individual bearing... automatically
BLISS Power Press
BIJUR
AUTOMATICALLY Correct LUBRICATION
● Remember them? Oiling time lost from productive work . . . Lubricant wasted . . . Production delays . . . Increased depreciation.
● How those hidden costs gnawed at profits! Money that now is clear . . . simply by the convenient, economical use of BIJUR lubricated machines. Clean lubricant is pumped and fed automatically . . . to each bearing the correct oil film it individually requires. No lubrication troubles . . . even to think about!
BIJUR LUBRICATING CORPORATION
LONG ISLAND CITY NEW YORK
707

They Take Up Their Own Wear

by the action of centrifugal force.
LEIMAN BROS. PATENTED
Rotary Positive Blowers
and
Vacuum Pumps

Power, Efficient and Noiseless. Use for paper feeding and handling, bottle filling, gas and oil furnaces, agitation and hundreds of other uses.


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder.
No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

A DUST COLLECTOR for Your Surface Grinder

A powerful apparatus for keeping fine grinding dust away from your work and from your own lungs.

It's a Great Protection Against Lung Dust Diseases

Get the free information.

Machine Design Can Be Greatly Helped

by using air movement instead of mechanical devices. Consult with our experienced engineers about air pumps and their uses

LEIMAN BROS. PATENTED
Rotary Air Pumps

are standard equipment on many automatic machines.

LEIMAN BROS., INC.
177 Christee Street, Newark, N. J.
LEIMAN BROS. New York Corp., 23 Walker St.
Makers of Good Machinery for 50 Years.

SPUR GEAR REDUCERS

(PLANETARY DRIVE TYPE)

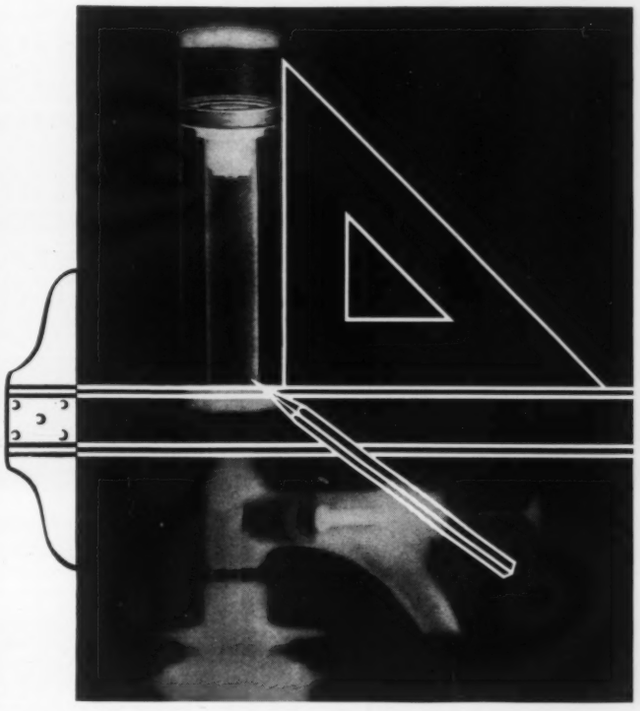
* This type of reducer is sturdy, compact, durable, efficient, and is equipped with Timken Roller Bearings

The D. O. James Planetary Spur Gear Reducer is superior to any other type, having a gear arrangement that produces the highest possible gear ratio.

D. O. JAMES MANUFACTURING CO., 1120 W. MONROE ST., CHICAGO

D.O.JAMES

FOR ALMOST FIFTY YEARS MAKERS OF EVERY TYPE OF SPEED REDUCER AND CUT GEAR



X-Ray The Packing Point... before the machine is built!

It's the design stage where the packing problem should be dismissed forever. Rather than OK the completed design and then take chances on getting the packing right . . . have Graton & Knight engineers visualize the packing requirement right from the drafting board. They'll make the proper recommendation, and save you trouble later on.

Add to this "X-Ray Thinking" of our engineers, the water-, oil-, gas-, heat- and air-resistant qualities of special packing leathers developed in the Home of Research . . . and the packing problem won't be the customer's worry either.

2032% ABOVE PAR AT PACKING POINT

For both constant and intermittent operation in gasoline, engineers set a mark of 25,000 strokes as par for a certain delicately-shaped packing. The ones specially designed by the Home of Research stood up satisfactorily for 508,000 strokes.

Write or wire *your* Packing Point* problem.

Graton and Knight
HOME of RESEARCH
WORCESTER, MASS.

**The point in any design where the choice of the right packing comes up.*

duction of ball bearings, and later to roller bearing manufacture; while now over 90 per cent of the company's business is devoted to the manufacture of taper roller and straight roller bearings.

* * *

American Chain Co. Inc.. 230 Park avenue, New York, has announced a change in corporate name to that of American Chain & Cable Co. Inc.

* * *

Wyckoff Drawn Steel Co., Pittsburgh, has announced a recent promotion, that of A. A. Bialas as vice president and general manager of sales.

* * *

John J. Campbell has been transferred to the Baltimore office of Eastern Rolling Mill Co., Baltimore, as sales manager. He formerly was district sales manager at New York.

* * *

Howell C. Cunningham, who has been secretary of the Crucible Steel Casting Co., Lansdowne, Pa., since 1912, has been elected vice president and treasurer. H. L. McClees, associated with the company since 1918, has been elected secretary.

* * *

For the past ten years department sales manager of Wheeling Corrugating Co., Wheeling, W. Va., R. I. Schuppener, has been made general sales manager of the new building products division, Berger Mfg. Co., Canton, O., a subsidiary of Republic Steel Corp. A complete line of building products under the Berloy blue label line trademark will supplement the company's line of sheet metal products.

* * *

Formerly general sales manager of Norton Co., Worcester, Mass., Harry K. Clark has been named a vice president of the company. W. LaCoste Neilson, vice president, director of sales and foreign plants, was renamed in that capacity.

* * *

B. J. Brugge, who has spent two years superintending welding operations in the Near East, has been appointed to the sales staff of the Los Angeles office of Lincoln Electric Co., Cleveland. Other appointments of Lincoln Electric to the sales staff at its Chicago office, located at 1455 West Thirty-seventh street, are: Robert A. Wilson, George Mandula and A. T. Cox Jr.

* * *

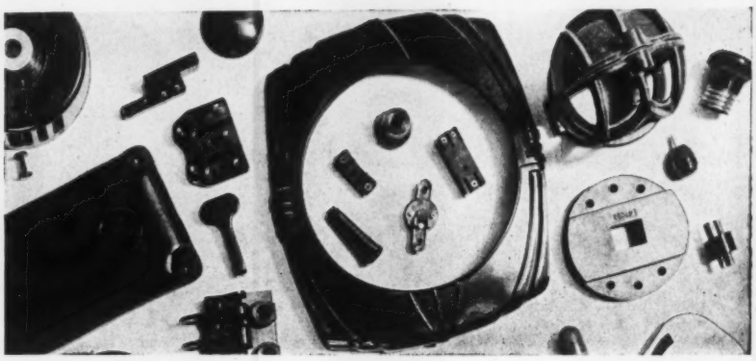
Charles B. Veith has been appointed sales manager of the Wright Mfg. division of American Chain & Cable Co. Inc., with headquarters at York, Pa. S. J. Woodworth becomes district manager of the Wright division in the New York territory, with headquarters at the New York Central building, 230 Park avenue, New York.

* * *

Peter L. Conway will handle sales of Link-Belt Co.. Chicago, in the area immediately to the south of Chicago, including South Chicago and Gary, with headquarters in Chicago, while Mike J. Parykaza has been assigned to handle sales of the company in the north

First Choice of Leading Designers

From an almost invisible part for a delicate precision instrument to the giant bearings that cradle an ocean liner's propeller shaft, INSUROK is serving industry in countless ways. Leading designers, quick to appreciate the versatility of this amazing plastic, have shown their unqualified approval of INSUROK by incorporating it in a host of products.



INSUROK *the Superior Plastic*

Of known chemical, physical, structural and dielectric characteristics, INSUROK improves every product of which it becomes a part, giving it fine performance, greater durability, longer life, and added sales appeal. Get all the facts. Write for literature and copy of the INSUROK Handbook.

The RICHARDSON COMPANY

Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati) Ohio
New Brunswick, N. J. Indianapolis, Ind.
Detroit Office: 4-252 G. M. Building, Phone Madison 9386
New York Office: 75 West Street, Phone Whitehall 4-4487

VERY 'NIFTY' IN THE '90'S

Fingers slip and slide on the out-moded, smooth head Cap Screw . . . and 99 of every 100 mechanics start to drive screws with their fingers. Slowed production, mounting costs are the penalty.

But, not *Now!*

Gone are the days of the natty gentlemen of the nutty 90's. Gone are the horrors of their hirsute presence. For which, due thanks!

Yet, their spirit lingers on in many a shop where old-fashioned smooth head cap screws are still in use—despite the recognized advantages of the *Knurled* "UNBRAKO".

"UNBRAKO" is the Socket Head Cap Screw—and the *only* one—that gives a non-slip grip in starting to drive the screw with the fingers . . . speeding production. And, it's the *only* Cap Screw that can be readily locked.

Bulletin 503 will be sent upon request.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. BOX 102 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

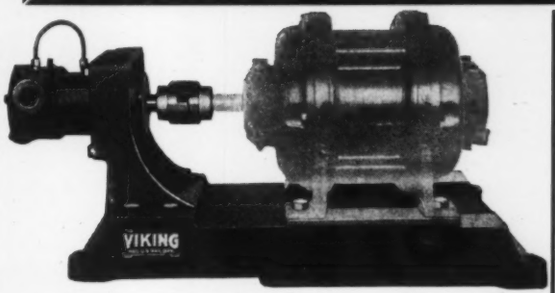
Pat. Pending

The Knurled "UNBRAKO" can be held firmly, driven faster with nary a slip. With it, there's no lost time or motion.

And, remember, it can be *easily locked*—the only screw with this feature.

VIKING ROTARY PUMPS

PROVEN DEPENDABILITY



We said so . . . industry proved it, that Viking Rotary Pumps are dependable, efficient, economical to own and operate. Viking's famous patented principle, "A Gear Within A Gear" has been the solution to thousands of knotty pumping assignments. Small first cost, nominal upkeep and low power consumption are only a few of the reasons why Viking Hydraulic Oil Pumps have been given "first place" by industry. Let Viking solve your problems . . . write today for bulletin and prices.

Viking Pump Co.
Cedar Falls, Ia.

ball-and-socket bearings

QUICKER adjustments! . . . accurate adjustments! . . . without machining, grinding or filing! You simply p-e-e-l one or more precision laminations at a time from the solid laminated shim. They save in the original precision assembly . . . and add a selling feature to your equipment . . . quick, ACCURATE service adjustments for the life of the bearing! Either .002 or .003" laminations.

LAMINUM
Precision adjustment **SHIMS**

LAMINATED SHIM CO., 21-26 44TH AVE., LONG ISLAND CITY, N. Y.